

B.R.181

(late O.U. 5040)

# HANDBOOK

FOR

## THE 6-INCH BREECH LOADING

## MARK XII. GUN

ON

P. VII., P. VII.\*, P. IX., P. XIII., & P. XIII.\*

MOUNTINGS.

1917.

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Attention is called to the penalties attaching to any infraction of the  
Official Secrets Acts.

B.R.181 - Handbook for 6-inch B.L. Mark XII  
Gun on P.VII, P.VII\*, P.IX, P.XIII and  
P.XIII\* Mountings, 1917 (late O.U.5040).

#### Amendment Slip No.2.

(Amendment Slip No.1 is cancelled).

Page 33. Line 42 ) ~~Delete~~ the word "individual" and substitute

Page 39. Line 27 ) the word "quarters".

Page 39. Firing Gear (Electric). ~~Delete~~ paragraph 3 and substitute:-

The box contacts, fitted at the breech end, have been converted  
into interceptors, and are arranged so that the gun can be fired  
when within one inch from the complete run out position.

In order to prevent defective working of these interceptors,  
due to incorrect positioning of the brackets, rendered possible  
by clearance between securing bolts and bolt holes, two dowel pins  
per bracket are to be fitted by the ship's staff.

Page 46. Line 34.

~~Delete~~ the word "individual" and substitute word "quarters".

ADWIRALTY, S.W.

(Gunnery Branch - G.3336/31)



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# **THE 6-INCH BREECH LOADING**

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ADMIRALTY,  
GUNNERY BRANCH.

G. 21117/17.



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CHAPTER I.  
THE MARK XII. GUN.

The Mark XII. is a high velocity gun of 45 calibres, and is mounted in Battleships and Light Cruisers. The P. IX. is a Battleship mounting, and the P. VII., P. VII.\*, P. XIII., and P. XIII.\* are Light Cruiser mountings. The P. VII., P. IX., and P. XIII. mountings carry armoured shields, and the P. VII.\* and P. XIII.\* spray shields only. The following are the chief particulars relating to the gun:—

WEIGHTS OF GUN AND MOUNTINGS.

	P. VII. T. C. Q. lbs.	P. VII.* T. C. Q. lbs.	P. IX. T. C. Q. lbs.	P. XIII. T. C. Q. lbs.	P. XIII.* T. C. Q. lbs.
Gun and Breech Mechanism	6 18 2 0	6 18 2 0	6 18 2 0	6 18 2 0	6 18 2 0
Cradle and Fittings	2 18 0 0	2 18 0 0	2 18 1 24	2 19 3 8	2 19 3 8
Pedestal ...	1 5 3 0	1 5 3 0	1 11 1 23	1 16 1 0	1 16 1 0
Carriage ...	2 13 0 0	2 13 0 0	1 12 1 8	3 0 2 0	3 1 1 0
Shield ...	5 4 1 18	0 18 0 0	3 5 0 0	5 13 0 22	1 2 3 0

*Full Charge.*—Cordite 27 lbs. 2 ozs. M.D. size 19 made up in two-third and one-third charges laced together and supplied in "W" rectangular cases.

Muzzle Velocity full charge at 80° Fah. for new gun — 2,845 f/s.  
Muzzle Velocity reduced charge at 70° Fah. for new gun — 2,090 f/s.

Range tables are compiled for M.V.'s of 2,825 f/s. and 2,075 f/s. for full and reduced charges respectively.

This gun has a greater chamber pressure than other 6-inch guns and the projectiles are designed to withstand a pressure of 20 tons per square inch. They are marked "A.Q.," "A" being the 4 C.R.H. and "Q" being special for the 6-inch Mk. XII gun. No other projectiles may be used in the Mark XII. gun.

PROJECTILES.	FUZE.	BURSTERS.
Capped Pointed Common Mk. VIII. "A.Q."	No. 15	10 lbs. Pebble Mixture,
Armour Piercing Capped "A.Q." ...	No. 15	4½ lbs. Large Grain.
H.E. Mark IX. and XII. (night tracers fitted in some) and XIV.	No. 13 or 45	10 lbs. 15 ozs., including Exploders.
Shrapnel Mk. XV. (874 bullets, 27 to the 1lb.) (Two-inch Fuze Hole.)	No. 84 or 81	
Practice Shot (night tracers fitted in some), M. IV. and M. V.		

\* No more No. 13 fuze are being manufactured, present stock is being used up.

*Tubes used—*

V.S. Percussion, large, Mark I. or II.

V.S. Electric, large, Mark III., IV. or V.

*Cartridge Case.*—Waterproof Duck Bag, No. 47.

*Maximum Elevation.*—14°.

*Maximum Depression.*—7°.



*Initial Compression on Springs.*—Total for gun, 8,460 lbs.; firing ditto, 16,920 lbs.

*Length of Recoil (full charge).*—16.5 inches.

The "E.B." (Mark I.) electric and the "P.B." (Mark I.) percussion locks and the box slide "K." Mark I., are used.

#### THE GUN (Plate 1).

The gun is of steel and consists of tubes, a series of layers of steel wire, jacket, breech bush, breech ring, and rings securing wire. The "A" tube is lined with an inner "A" tube extending from the seat of obturator to the muzzle. The inner "A" tube is secured longitudinally by, (i.) corresponding shoulders over the seat of obturator and immediately in front of the chamber, the portion of the tube in front of the first shoulder tapering towards the muzzle, and, (ii.) the breech bush which is screwed into the "A" tube at the rear; the breech bush is also prepared for the reception of the breech screw.

Over the "A" tube are wound successive layers of steel wire having the ends secured to steel rings.

The C "Ring Securing Wire" which is shrunk over the muzzle end of the "A" tube projects slightly at the muzzle.

The jacket is fitted over the wire, securing rings and a portion of the "A" tube, and is secured longitudinally by corresponding shoulders and the breech ring which is shrunk over the rear end of the "A" tube and secured to the jacket.

The breech ring is prepared for the breech mechanism and is furnished on the upper side with projections for attaching the run-out springs of the mountings; a lug is also formed on the under side of the ring for the attachment of the gun to the piston rod working in the recoil cylinder.

Securing screws are provided in the breech face to prevent the breech bush and breech ring from turning when in position.

Projecting keys are formed on the upper and lower sides of the jacket, immediately in front of the breech ring, which serve as guides for the gun when in the cradle of the mounting.

The central portion of the chamber is cylindrical and reduced in diameter at the front and rear.

Axis lines are cut at the breech and muzzle ends on the right and left sides. Vertical and horizontal lines are also cut on the breech and muzzle faces.

A plane for clinometer is prepared on the upper right side of the breech ring. A clinometer plane cover is fitted over the plane.

A preponderance band is fitted to the muzzle of the gun to counteract the additional weight of the director firing gear.

*Rifling.*—The gun is rifled on the polygroove system (plane section) with 36 grooves, depth .05 inch and width .3759 inch; the lands are .1479 inch in width.

The twist is uniform, one turn in 30 calibres.

The length of the rifling is 230.56 inches.

*Examination.*—The gun should be examined after each series of 50 equivalent full charges.

#### OTHER PARTICULARS.

Total length of gun	— — — — —	279.728 inches.
Length of bore from obturator seating	— — — — —	270 inches. 45 calibres.
Length of rifling	— — — — —	230.56 inches.
Length of chamber	— — — — —	36.2 inches.
Largest diameter of chamber	— — — — —	8 inches.
Smallest diameter	— — — — —	6.715 inches.
Capacity of chamber	— — — — —	1,770 cubic inches.
Chamber pressure in new gun	— — — — —	20 tons per sq. inch.
Distance of C. of G. (gun loaded and with breech mechanism) from breech face	— — — — —	93.75 inches.
Distance of C. of G. (gun unloaded and without breech mechanism) from breech face	— — — — —	96.0 inches.

#### THE BREECH MECHANISM (Plates 2 and 3).

The principal parts are:—

- Breech screw.
- Carrier, with hinge bolt.
- Catch retaining breech screw open.
- Breech screw lever, with sliding blocks.
- Bearing ring and ring retaining breech screw lever with set screw.
- Bar actuating withdrawing lever with spring and intermediate lever with roller and axis pin.
- Crank pinion, with roller bearer, inner and outer sleeves, washer, and securing screw.
- Breech mechanism lever (short or long) with catch retaining breech mechanism lever closed.
- Key retaining breech mechanism lever with keep screw.
- Breech mechanism lever pinion.
- Vent axial with obturator pad, sleeve, vent, rebound spring, collar and nut.
- Boxslide "K" with Percussion Lock "P.B." and Electric Lock "E.B."
- Link actuating lock.
- Shot guide lever.
- Shot guide.

*The Breech Screw* is of the Wellin pattern with a hardened steel piece for the catch retaining breech screw open to engage in; two studs project from its rear face, which work in the sliding blocks in the recesses on the breech screw lever. It is attached to the pintle of the carrier by screw threads as usual.

*The Carrier* is of bronze, hinged by a bolt to the right side of the breech ring, and has, inserted between its under side and the bearing on the breech ring, a bronze washer in which are cut lubricating grooves. It extends rather more than half way across the breech, and has on its front face a large circular projection which forms a pivot for the breech screw; on the exterior of this projection a square thread is cut, with the same pitch and number of interruptions as that in the recess of the screw. In rear of the square thread a continuous screw thread is cut for the ring retaining breech screw lever, and behind this there is a plain portion of



large diameter for the bearing ring. The projection is hollowed for the spindle of the vent axial and the sleeve, rebound spring, collar, and nut, which fit over the spindle, and is prepared in rear for the box slide.

A featherway is cut within the recess, on its left side, to accommodate feathers on the collar and sleeve.

On the upper edge of the front side a recess is formed for the reception of the catch retaining breech screw open, a small drift hole being drilled into the recess from the rear, in order to facilitate the removal of the catch. Near the right end a small projection is formed which acts as a pivot for the crank pinion. Near this, on the lower edge, a recess is cut for the reception of the axis of the breech mechanism lever.

Two steps are formed on the rear face of the carrier, one to support the lock and boxslide when in position and the other to prevent the box slide from being unshipped until the lever withdrawing needle is moved clear of it.

Lubricating channels closed by preserving screws are provided on the carrier.

The catch retaining breech screw open is a hollow cylinder of the usual type, containing a spiral spring, and fits into the recess in the carrier referred to above.

*The Hinge Bolt* is of steel, having at its upper end a projecting head to give the requisite bearing. At its lower end, the bolt is of smaller diameter than the remaining portion, and is provided with two feathers which engage in featherways in the shot guide lever. A nut and keep pin retain this last fitting, as well as the hinge bolt, in position. On the remaining portion an interrupted feather is formed which engages in a featherway cut in the carrier, thus connecting the hinge pin to the carrier.

*Vent Axial.*—The vent axial is of the usual type, the rear end being simply rounded off, the jaws of the extractor in this case being fitted in a recess in the box slide. The spindle is provided with a feather to work in the featherway in the sleeve.

*The Sleeve* consists of a short cylinder of steel, and is provided with an internal featherway and an external feather; being cylindrical it can be assembled with the other vent axial fittings.

*Obturator Pad.*—An obturator pad of the steep coned type, having an outer cover of wire mesh with front and rear protecting discs and front ring, is fitted over the vent axial in the usual way.

*Link Actuating Lock.*—The link actuating lock slides in an undercut groove cut across the carrier. At its left end it has a circular hole for the guide bolt of the lock to work in, the metal being cut away, to allow of the passing of the guide bolt when shipping or unshipping the lock. At its right end a stud is formed which engages in a circular hole cut in the body of the crank pinion.

*The Bar Actuating Withdrawing Lever*, works in a slot cut in the carrier; it is prevented from revolving by a feather which is formed on one side of it engaging in a featherway cut in the carrier. Attached to the bar is a spring plunger which is always tending to force the bar to the right. On the first motion of the breech mechanism lever when opening the breech, a projecting portion of the crank pinion rotates the

intermediate lever about its axis thus forcing the bar actuating withdrawing lever to the left against the spring plunger and moving the withdrawing lever on the box slide.

*The Breech Screw Lever* consists of a circular plate with a long projecting arm. The circular plate is mounted on a steel bearing ring on the carrier projection, in rear of the breech screw, and has two square recesses cut in it, at points diametrically opposite to each other, into which fit two gunmetal sliding blocks which are also internally recessed to receive the studs on the rear face of the breech screw.

The arm projects at right angles to a diameter joining the recesses for the sliding blocks, and has cut, in its rear face, a deep cam groove for the roller on the stud of the crank pinion.

The bearing ring fits over the pintle of the carrier, and forms a bearing for the breech screw lever.

The bearing ring has two flattened portions, by means of which it is connected to the breech screw lever. The breech screw lever is an easy fit over the bearing ring in the direction of the flats, and this, in conjunction with the motion allowed to sliding blocks in a direction at right angles, ensures the breech screw being truly centred.

The ring retaining breech screw lever is prepared with screw threads, by means of which it is secured to the carrier.

Its rear face bears against the lever, and thus holds it in position, and its front edges are shaped to fit into the rear face of the breech screw. To prevent the ring from unscrewing a set screw passes through it and screws into the carrier. When assembling the breech mechanism IT IS OF THE UTMOST IMPORTANCE TO PUT IN THIS SET SCREW; if it is omitted the ring retaining breech screw lever will unscrew from the carrier and jam the mechanism.

*Crank Pinion.*—Engaging with the groove in the breech screw lever is the stud of the crank pinion; the latter is mounted on a pivot forward on the front face of the carrier. Bevel teeth are formed on one end of the crank pinion to gear with corresponding teeth on the breech mechanism lever pinion. The stud provided is the usual roller, held in position by a washer and set screw. Working in a hole formed in the rear face of the crank pinion is the stud at the right end of the link actuating lock.

On the pivot of the crank pinion is placed a roller bearing, working between inner and outer sleeves, to reduce friction. The roller bearing consists of a hollow cylindrical cage, into which are fitted 28 rollers, free to revolve, but kept in position by a cap and securing wire.

The sleeves consist of plain hollow cylinders of steel. The roller bearings, sleeves, and crank pinion are secured in position, but permitted to revolve, by a flat circular piece of steel termed the washer, which is held by a large securing-screw passed through its centre and screwed to the pivot.

The washer has two feathers on the front face which enter featherways cut in the face of the pivot so that it cannot revolve, and a locking plate prevents the securing-screw from working loose. The washer is stamped with the word "top" on the rear face to guide in assembling.



*Breech Mechanism Lever Pinion.*—The breech mechanism lever pinion is made with bevel teeth which engage with those on the crank pinion. The end teeth and spaces are increased in width both on this pinion and the crank pinion to give the increased strength required when commencing to open or close the breech.

It fits in a small recess formed in the carrier, and fits over the axis of the breech mechanism lever, being keyed to the latter by two feathers.

*Breech Mechanism Lever.*—There are two types of breech mechanism levers, marked "long" or "short" respectively and are supplied as requisite to suit the casemate in which the gun is mounted.

Near the handle of the lever there is a spring catch retaining breech mechanism lever closed; this catch engages in a slot formed in the breech screw lever when the breech mechanism lever is in the "breech closed" position.

The axle of the lever is at the right end; a cannellured groove is cut round the lower part of the axis in which the key retaining breech mechanism lever lies; at the upper end two feathers are formed which engage in corresponding featherways cut in the breech mechanism lever pinion.

*Shot Guide Lever.*—A shot guide lever is connected to the lower end of the carrier hinge bolt by feathers and featherways, and is retained in position by a nut and keep pin.

A projecting arm forming the lever proper is suitably recessed for the reception of the ball-headed stud on the right extremity of the shot guide.

*Shot Guide.*—The shot guide consists of a bronze arm extending across the face of the breech immediately below the breech opening. It is connected to the gun by two guide-screws passing through grooves in the guide, the grooves being so shaped as to ensure the rising of the guide when the latter is drawn to the right in the action of swinging the breech screw and carrier to the loading position.

Castellated nuts screw on to the heads of the two guide screws and are secured by split pins.

At the right end the shot guide is fitted with a ball-headed steel stud with which the shot guide lever engages, and at the other extremity is curved upwards to protect the screw thread in the breech opening from being injured by the projectile whilst loading.

*Action of the Mechanism.*—In the following explanation of the action of the mechanism the gun is regarded as having been just fired, and the breech, therefore, fully closed. The action would then be as follows:—On drawing the breech mechanism lever to the right the catch retaining is disengaged from the recess cut in the breech screw lever. The breech mechanism lever pinion, which is attached to the axis of the lever is caused to rotate, and its bevel teeth engaging with those on the crank pinion cause the latter to revolve. The stud on the link actuating lock working in the recess in the crank pinion draws the link to the right together with the lock. With the first movement of the breech mechanism lever the bar actuating withdrawing lever is moved to the left thus working the withdrawing lever and withdrawing the striker from the base of the tube. The further movement carries the sleeve over the safety slide and the

needle away from its position opposite the tube, and thus forms the safety arrangement.

As the crank pinion revolves, its stud travels in the groove on the arm of the breech screw lever, turning the lever, and with it the breech screw, to the unlocked position, where it is brought to a stop by the arm coming into contact with the carrier. The slot in the flange of the screw is then opposite the catch retaining breech screw.

As the screw revolves, the pitch of its thread causes it to travel to the rear on the carrier projection, and, acting through the sleeve, spring, collar, and nut, forces the vent to the rear and unseats the pad. Due to the shape of the groove and the leverage obtained, considerable power is applied to start the pad from its seating on the first motion of turning the screw.

During the foregoing movement, as the lock is drawn to the right, the inner toes of the extractor, riding over projections on the face of the lock frame, prise the tube to the rear with a powerful unseating motion; this is the "Primary Extraction." As soon as the tube is unmasked the outer toes of the extractor engaging in the tripping piece eject the tube. Inclined planes at the left end of the extractor engage under corresponding inclined planes on the tube retainer thus forcing the tube retainer clear of the tube when the extractor is moved to the rear.

The further movement of the breech mechanism lever causes the carrier and breech screw to swing together to the loading position by reason of the last tooth of the breech mechanism lever pinion bearing against the last tooth of the crank pinion, which is incapable of further rotation by the arm of the breech screw lever engaging the stop on the carrier. As the carrier leaves the breech face, the catch retaining is forced outwards by its spring, and engages in the slot in the flange of the breech screw, so preventing any movement of the screw whilst the breech is in the open position. The swinging of the carrier causes its hinge bolt to turn, and with it the shot guide lever, which draws the shot guide to the right into the loading position.

*Closing the Breech.*—The tube is inserted through the jaws of the extractor while the breech is open, whereby the extractor is pressed forward and inclined planes at the left end of the extractor force in on corresponding inclined planes on the tube retainer, thus forcing the latter clear of the tube chamber until the tube has passed, when its spring again forces it back behind the head of the tube, and so holds it in position as the mechanism strikes the breech face on closing. The toes of the extractor then rest in recesses in the lock frame.

The gun having been loaded, the breech mechanism lever is pushed to the left, causing its breech screw and carrier to swing round, the former into the breech opening and the latter against the face of the breech; the shot guide lever during the movement pushes the shot guide to the left, clear of the breech opening. As the carrier reaches the breech face, the catch retaining is forced within its recess, clear of the breech screw, and leaves the latter free to revolve.

The forward motion of the lever being continued, the breech mechanism lever pinion and crank pinion are revolved in the reverse direction to that already described, and the breech screw lever and breech screw are thereby turned to the locked position.



During the turning of the screw, and conforming to the pitch of its threads, it travels slightly forward on the carrier projection and pushes the pad into its seating, and the vent spring pressing against the rear of the sleeve maintains its contact between its front end and the breech screw.

As the turning of the breech screw proceeds, the lock, acted upon by the link engaging in the cam pinion, is forced to the left, and consequent on this movement the toe of the extractor rides out of the recess in the lock frame, and presses the tube a short distance to the rear, until it is checked by the retainer.

The further movement of the breech mechanism lever causes the bevel on the left end of the lock frame to ride over the tube, forcing it into the vent, and carrying the arms of the extractor with it. The last movement of the breech mechanism lever brings the needle of the lock in line with the tube, and carries the sleeve clear of the safety slides, allowing the mainspring to force the striker forward into contact with the tube ready for firing. The lever is now home, resting against the rear face of the breech screw lever, with which its catch engages to retain the breech mechanism lever in the closed position.

*Percussion Firing.*—The action of the mechanism is as described above, the lock being cocked as it moves to the right in the operation of turning the breech screw. The friction rollers on the sleeve ride up the incline on the left end of the cocking slides, compelling the striker to move to the rear, and with it the collar securing, thus compressing the mainspring. When the striker reaches the cocked position, the toe of the trigger sear by the action of its spring engages the front of its sleeve, and retains it until the moment of firing.

The hook of the lanyard is connected to the trigger, to which it is held by the spring retaining lanyard.

On the lanyard being drawn either to the right or left, the trigger is revolved, and with it the pawl, one arm of which forces the trigger sear to the right, clear of the sleeve, which leaves the striker free to go forward. As the mainspring expands the collar securing and the striker are driven forward until the former is stopped by the lock frame, but the striker, by its momentum, is carried through the collar securing, and the firing pin strikes the tube and fires the gun. This last movement is limited by the sleeve coming into contact with the case.

*Rebound Action.*—When the lanyard is pulled clear of the trigger, the spring of the trigger sear re-asserts itself and returns the sear, pawl, and trigger to the normal position. As the trigger sear revolves its toe rides down an incline at the rear end of the recess in the sleeve, and in doing so withdraws the sleeve and striker, clearing the firing pin from the tube and so forming the rebound action.

*Safety Arrangements.*—The breech must be closed and the breech mechanism lever "home" to bring the needle or striker in line with the tube and to clear the safety levers from the slides, also to enable the bar actuating withdrawing lever to be forced to the right clear of the withdrawing lever by the action of its spring, and in the case of the percussion lock to clear the sleeve from the cocking slides, so as to admit of the needle or striker going forward into contact with the tube.

In the case of a missfire, the tube may be extracted and a new one inserted without opening the breech of the gun as follows:—

In the Electric Lock draw the lanyard attached to the lever withdrawing guide bolt to the right thus pulling the lock to the right as far as possible and ejecting the tube. Insert a new tube and force the lock back to the left, seeing that the lock guide bolt re-enters the hole in the link actuating lock.

In the Percussion Lock cock the lock, draw the lock guide bolt as far to the rear as possible and force the lock to the right. Insert a new tube and force the lock back to the left as in the case of the electric lock.

The locks may be changed in the above way.

*To Strip the Mechanism.*—The breech of the gun should be fully opened to remove the fittings, except when removing the carrier, which must be taken off when in the closed position in order that the feathers on the hinge bolt may coincide with the featherway in the upper bearing of the breech ring.

The wrenches and tools used with this mechanism are:—

Wrench Breech Mechanism No. 41 for all large nuts. This is simply a double-ended spanner, one being for the nuts of the carrier hinge bolt, the other for the guide screws of the shot guide.

Wrench Breech Mechanism No. 47 for needle and vent axial nuts, adjustable bush, catch retaining breech mechanism lever closed and small screws.

Wrench Breech Mechanism No. 48 for ring retaining breech screw lever and all large screws.

#### THE BOX SLIDE "K." (Plate 4.)

The Box Slide, of steel, is cylindrical at the front, with interrupted thrust collars on the interior to engage the axial vent.

Two projections are formed on the front face to gear with similar projections on the vent axial nut. The rear portion is prepared with flanges, having undercut grooves, to accommodate the lock. On the upper side is the *lock sleeve withdrawing lever* and at the left end the slide box is recessed to receive a *tube retainer*; while at the rear of each flange a *cocking and safety slide* is secured by two screws to keep the lock sleeve to the rear until the final closing movement of the breech, and, when firing by percussion, to cock the lock.

Outside the upper slide a projection is formed to act as a bearing to the plunger of the lock sleeve withdrawing lever.

The *lock sleeve withdrawing lever* is pivoted to the upper side of the box slide, and is kept pressed towards the front by a plunger, with spiral spring, fitting into a recess in the lock sleeve withdrawing lever and bearing against the projection outside the upper sleeve previously referred to. At the left end the lock sleeve withdrawing lever projects downwards and engages with the prolonged arm of the lock sleeve; and at the front it has an arm to engage the bar actuating withdrawing lever.

Near the rear end is a projecting lug to form a stop to the box slide when removing the lock from the gun. A roughened thumbpiece in rear of



this lug enables the lock sleeve withdrawing lever to be revolved to the rear, and so clear the stop on the carrier, when removing the box slide from the vent axial.

The *tube retainer*, with its spiral spring, fits in a recess on the left of the box slide. It is bent to the rear at its left end, this bend being roughened to give a grip to the finger when operating the retainer by hand. At the right end it is formed into a small arm, curved at the rear, to engage the head of the tube, this arm being between the jaws of the extractor.

Bevels are provided on the front and rear faces of the tube retainer; those on the rear face force the tube retainer to the left whilst inserting a tube, and those on the front face force the tube retainer to the left during the "Final Extraction" thus allowing the tube to come to the rear past the tube retainer.

The extractor is very strongly made and at its right end has two unseating toes which engage with the cams cut on the needle guide block, thus giving "Primary Extraction." To the left of these are two other toes which engage with the tripping toes on the further movement of the breech mechanism lever, thus giving "Final Extraction." Two inclined planes on the jaws of the extractor return the tripping levers to their proper position as the breech is finally closed. The head of the extractor axis pin is covered by the lock sleeve withdrawing lever which fitting must be removed before the axis pin can be taken out.

#### THE PERCUSSION LOCK P.B. (Plate 4.)

The percussion lock P.B. consists of lock frame, striker, mainspring and case, sleeve, cocking handle, trigger, and sear, needle guide block, tripping pieces guide bolt with adjustable bush.

The *lock frame* is of steel with two sides dovetailed to work in the guides of the box slide; one end is bored out to receive the mainspring case, while immediately in front of this the face is cut away to receive the needle guide block.

Above and below this cut away portion are recesses in which the tripping pieces work.

The other end of the lock frame is bored out to receive the guide bolt with adjustable bush, the latter being held in position by a projection on the bush working in an undercut groove in the lock frame and a locking plate with fixing screw.

Between the mainspring case and the guide bolt a bracket is dovetailed on to the lock frame to receive the trigger and sear called the *trigger bracket*.

The *striker* is of steel, and consists of three parts, viz.:—spindle, firing pin, and retaining nut.

The spindle is threaded on the front end to screw into the retaining nut, and has a milled collar, against which this butts; towards the rear the spindle is enlarged in diameter where it passes through the mainspring case, while beyond this it is reduced to take the sleeve, a projecting key on this portion preventing the spindle from turning. The rear end is screwed to take the cocking handle, which also acts as a nut retaining the sleeve. Gas ways are cut in the enlarged part of the spindle.

The retaining nut is cone shaped at the front and cylindrical at the rear, being provided with serrations to engage in those of the securing collar. The nut is bored out to take the needle point and screws on to the front end of the spindle.

The needle point is of hardened steel and fits inside the retaining nut with its end projecting through the same; the other end bears against the end of the spindle. The point can thus be easily replaced if broken.

The collar securing firing pin retaining nut is of steel and has two functions. It fits inside of the mainspring case at the front, resting against the firing pin bush in the lock frame, while the mainspring bears against its rear face; inside it is bored out to two diameters, the larger at the front being serrated to engage with the corresponding serrations on the collar of the striker spindle and the retaining nut, thus preventing this nut from turning upon the spindle; the reduced diameter at the rear forms a shoulder which bears against the collar on the striker spindle thus conveying the impact from the mainspring to the striker. The position of this shoulder relative to the collar gives a small amount of free movement to the spindle, so that the mainspring cannot press the firing point beyond the face of the lock frame, the actual impact causing the point to enter the tube being due to the momentum. This free movement enables the striker to be easily withdrawn from the tube.

The *mainspring* is of steel (nickel plated) of flat section and surrounds the striker.

The *mainspring case* is of steel. It is bored out to take the mainspring, and in the rear there is a hole through which the spindle of the striker passes, while at the front end it is internally threaded to screw over the needle guide block and serrations are cut on the outside circumference of the front end to enable the mainspring case to be secured by the locking plate and set screw. Two air escape holes are drilled in the rear of the case.

The *sleeve* is of steel, and has projecting bosses above and below, to each of which a bearing plate is screwed by two screws. The front end of these projections are bevelled and provided with holes to take hardened steel anti-friction rollers (one at each side) which revolve between the plates and the sleeve in recesses provided for them in the latter.

These rollers engage with the cocking and safety slide on the box slide. The upper projection is longer than the lower and is rectangular at the end to engage the lock sleeve withdrawing lever, thus withdrawing the striker to the rear with the first motion of the breech mechanism lever.

The inside of the sleeve is bored out to fit the outside of the mainspring case. In the rear end of the sleeve a hole is cut to take the end of the striker spindle, a small keyway being provided to take the key thereon.

Two air escape holes are drilled in the rear end of the sleeve. On the right of the sleeve are two projecting lugs which guide the trigger sear, and between these lugs are two projections which engage the sear, the front one is the cocking stop, this being bevelled at the rear to press the sear back whilst cocking. The rear stop is bevelled at the front, and when the sear is returning to its normal position after firing it strikes upon this incline, thus withdrawing the point of the striker from the tube. It is therefore impossible to fire a tube, however violently the breech may be slammed.



The *trigger sear* is of steel, and is pivoted to the trigger bracket at its foremost end, the other being curved to clear the actuating pawl; a flat spring fixed on the inner side presses against the mainspring case, beyond the axis, thus pulling the sear inwards. The *pawl actuating trigger sear* is bored and keywayed to take the pawl pin; on the pawl are two projecting toes, which engage with bearing points on the sear in such a manner that the sear is released by a movement of the pawl in either direction.

The *trigger* is of steel and can be actuated from either side. The front end is forked to take the lanyard spring clip, which works in slots provided for it. The rear end of the trigger has a boss on the upper side, with a square "D" hole to take the pawl pin; on this boss there is a projecting piece which engages in another projecting piece formed on the trigger bracket, thus limiting the movement of the trigger in either direction.

The *trigger axis pin* is of two diameters with a projecting head. The larger diameter passes through the upper side of the trigger bracket, the smaller diameter passing through the pawl and lower side of the trigger bracket. The lower end is fitted to take the trigger, this being secured in position by a split pin. A projecting key on the axis pin engages in the keyway in the pawl, which is thus coupled to the trigger.

The *needle guide block* fits into a recess in the lock face and is held in position by the mainspring case, which is screwed on to a threaded boss formed on the rear face of the needle guide block. On its front face cams are formed which actuate the inner toes of the extractor, thus giving "Primary Extraction." At the left end it is bevelled to press the tube into the tube chamber during the final closing movement of the breech. A recess is cut at the left end to make a clearance for the tube retainer when the lock is in the closed position.

A hole is drilled in the face of the needle guide block through which the firing pin strikes the tube when the lock is fired.

A gas escape hole is drilled diagonally on the right side of the boss.

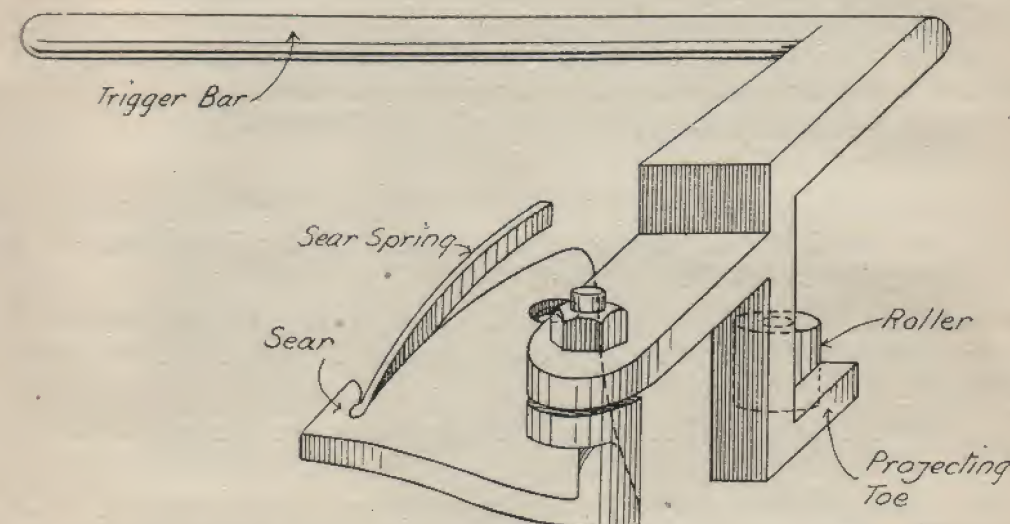
The *guide boss* and *adjustable guide bolt bush* are of steel, the latter being bored out to receive the bolt and spiral spring.

The *guide bolt* is in two diameters, the larger end engaging in the hole in the link actuating lock, while the spring surrounds the smaller diameter, resting against the shoulder; the rear end passes through a hole in the bush, and is threaded to receive the loop, which screws on, being secured by a split pin.

The outside of the bush is eccentric, and is retained in the lock by a projection on the former, working in an undercut groove in the latter. The bush is prevented from turning by means of serrations round the outer edge and a locking plate with set screws. Graduations reading from 0 to .05 inch, each successive number representing .01 inch horizontal movement of the lock are engraved on the bush, and an arrow is engraved on the lock on the right.

An arrow is also cut on the rear face of the bush and marked "Enter"; when the bush is revolved so that this arrow coincides with the arrow on the lock it may be drawn clear of the latter. By means of this adjustable guide bolt bush the lock can be adjusted for the eccentricity of striker.

The accompanying woodcut shows the modifications which are made to the percussion lock "P.B." to suit it for *Percussion Firing Gear* (*Mechanical*). The form of the sear is modified and the actuating pawl, pawl axis, and trigger are removed. A right-angled trigger bar replaces the latter and is pivoted to an axis formed on the sear; a portion of the base of this axis is cut away to form a clearance for the trigger bracket. A toe is formed on the lower end of the trigger bar and projects to the front, its left edge bearing against a hardened steel roller revolving on an axis between the two faces of the trigger bracket, to the right of the sear axis.



The action is as follows:—

On the trigger bar being forced to the rear the projecting toe on the former presses against the roller which now becomes the fulcrum, thus forcing the sear to the right by means of the axis connecting the trigger bar to the sear, releasing the sleeve, and firing the lock.

#### THE ELECTRIC LOCK "E.B." (Plate 5.)

The electric lock "E.B." consists of the lock frame, striker, mainspring and case, sleeve, needle guide block, tripping pieces, guide bolt with adjustable bush, guide bolt withdrawing lever and spring connections for expendable cables.

The *lock frame* is similar to that for the "P.B." lock with the following exceptions:—

- (i) No trigger bracket is fitted.
- (ii) At the right end of the frame two lugs are formed between which the guide bolt withdrawing lever is mounted, and the lock frame is suitably recessed to form a clearance for the toe of the guide bolt withdrawing lever to work in.

The *striker* is of steel, the front end being enlarged to form a collar against which the mainspring butts, this collar also keeping the striker central in the insulating bush.

Gas escapes are cut longitudinally on this collar. The rear end is screw threaded for the securing nut and spring connection for expendable cable and has a slot in its face for taking a screwdriver.

An insulating washer is inserted under the securing nut to insulate the striker from the sleeve.



The spring connection for expendable cables enables the latter to be shifted very rapidly by withdrawing the brass milled cup to the rear against the action of the spring. A preserving screw fits in to the rear end of the spring connection.

The *main spring* is of steel (nickel plated) of round section and surrounds the striker, bearing against the collar on the same and the rear end of the mainspring case.

The *mainspring case* is of steel and of two diameters, externally and internally, the smaller diameter being to the rear. The smaller diameter fits over the mainspring and the larger diameter is internally threaded to screw on to the boss formed on the rear face of the needle guide block; serrations are cut around the front end to enable the spring case to be secured to the lock frame by a locking plate and screw.

In the rear face there is a hole through which the needle bearing bush with insulating collar pass.

The sleeve is of steel and is bored out to fit over the mainspring case, a key on the right side engaging in a keyway on the lock frame, thus preventing the sleeve from turning.

A hole is drilled in the rear end of the sleeve through which the needle bearing bush protrudes, the latter being insulated from the sleeve by an air space.

On the rear face two horns are formed to enable the sleeve to be drawn to the rear by hand.

On the right there is a projecting lug under which the toe of the guide bolt withdrawing lever engages. There are two projecting bosses on the front face of the sleeve which engage with the safety slides on the box slide when the lock is drawn to the right. The upper boss has a rectangular projection which engages with the lock sleeve withdrawing lever, thus withdrawing the striker to the rear with the first motion of the breech mechanism lever.

The *needle guide block* is identical with that described for the percussion lock "P.B." with the exception, that the interior of the threaded boss on the rear face of the guide block is lined with an insulating bush and insulating washer.

The *guide bolt* and *adjustable guide bolt bush* are identical with those described for the percussion lock "P.B."

The *guide block withdrawing lever* is pivoted to the two lugs on the lock frame. The lever is cranked; one arm has an eye for the attachment of a lanyard and in the other arm is an elongated hole through which the lock guide bolt passes, whilst, at its other end, there is a toe which engages under the projecting lug on the right side of the sleeve.

The action is as follows:—

The lever is revolved by means of the lanyard attached to the eye, and, bearing against the lock guide bolt, withdraws the latter from the link actuating lock.

At the moment the guide block clears the link, the toe at the end of the lever arm forces the sleeve, and consequently the striker, to the rear clear of the base of the tube.

Continued pulling on the lanyard slides the lock to the right across the face of the carrier.

## CHAPTER II.

### THE P. VII. MOUNTING.

#### THE PEDESTAL. (Plate 8.)

The Pedestal is of forged steel, having a circular base which is secured to a steel packing ring by twenty 1.75-inch diameter bolts.

The interior of the Pedestal is recessed and provided with suitable upper and lower bronze bushes and with bearings to suit the carriage pivot.

The upper roller bearing consists of 36 and the lower of 24 bronze rollers carried in cages. These rollers being a closer fit to the pivot than the solid bushes underneath support the pivot during training, but yield slightly under the firing blow and so enable it to be taken largely on the solid bushes. Underneath the lower bush a recess is provided for the footstep roller bearing, which supports the weight of the revolving mass. This roller bearing tray is contained in a manganese bronze bearing tray fitted to slide in and out of the pedestal from the rear when required for examination.

#### THE FOOTSTEP BEARING.

The footstep ball bearing consists of a cup provided with lugs containing the upper and lower ball race, the balls themselves and a mushroom-shaped cover on which the base of the pivot actually rests. This cover is a fine fit in the bore of the upper ball race, and its exterior circumference is a fine fit in the cup. The mushroom-shaped piece is provided with a screwed hole for an eye bolt. Attached to the cup by the lugs is a gun-metal slide, which reaches practically to the exterior surface of the pedestal, where it is provided with a withdrawing handle; a special countersunk bolt serves to keep the ball cup in the exact position. The opening through the pedestal wall is covered with a watertight brass cover.

#### THE TRAINING RACK AND CLAMP.

The Training Rack is of steel and is only "frictionally" attached to the pedestal; it is prevented from rotating by two friction clamps on the pedestal. These clamps have steel jaws like a vice, which are tightened on to a downwardly projecting flange on the worm wheel by a screw, which is operated by a ratchet clamping handle. The clamps are screwed up until the friction is sufficient to prevent the mounting slipping in training under ordinary working, but are not sufficiently tightened to prevent slip under undue shock, due to blows or sudden stoppage. To prevent the handle fouling any of the revolving gear, it must be always left hanging in a vertical position.



## THE CARRIAGE.

The carriage is of forged steel in the form of a Y bracket, recesses being formed in the inside of the side cheeks to take the trunnion blocks. The weight of the carriage and pivot is taken on the footstep roller bearing in the base of the pedestal and the pivot is supported horizontally by two roller rings.

A collar is formed upon the shank of the pivot against which the forked lifting lever in the pedestal takes. The left cheek of the carriage is suitably recessed to take a rearwardly projecting side bar which carries the elevating worm gear box; a forward projection on the same bar carries the two-speed gear box and elevating handles. The right hand cheek is suitably recessed for a smaller side bar, which carries the trainer's seat and part of the training gear. To the under face of the carriage are secured clips for supporting the training worm wheel, and both cheeks are provided with screwed holes for the attachment of the shield stays. The lower part of the carriage has attached to it the cover plates and training worm bracket forming the upper part of the oil bath which surrounds the training worm wheel.

## LIFTING GEAR. (Plate 8.)

The lifting gear as fitted consists of a forked lever, the fork embracing the carriage pivot and the other end projecting through the pedestal wall. On the lower face of the lifting lever are two rounded fulcrum points which rest on the floor of the pedestal recess, and on the upper surface at the end of the fork two similar fulcrum points which take against the lifting shoulder on the carriage exactly on the axis plane. The outer extremity of the lifting lever is pierced for the lifting bolt which passes through it, and is tapped into the metal of the pedestal lower down; a spherical washer is placed under the head of the bolt, and a smaller collar with pin embraces the bolt under the lever. To lift the pivot the bolt is screwed down into its nut, thus rotating the lever round the lower fulcrum and so prising the pivot upwards; the whole bolt with the opening in the pedestal is covered by a watertight gun-metal cover. Before lifting the mounting the following points must be attended to:—

- (1) Slack right back the Training clamp on the Pedestal.
- (2) Slack right back the anti-backlash bolt in the Training worm wheel gear.

As an alternative method, the carriage may be raised a small amount by means of a dismounting bogie to enable the footstep bearing in the pedestal to be examined. Before doing this:—

- (1) Slack back elevation friction washers (if fitted).
- (2) Slack right back training clamps.
- (3) The usual method of taking the weight of gun muzzle, as when dismounted, should be adopted.

## SHIELD.

A cast steel armour plate shield is fitted varying in thickness from 3 inches in front to 1 inch in rear. Two bosses are cast on the top and screwed to take lifting eyebolts, one on each side. The screwed holes

are closed by preserving screws. Suitably recessed lugs are cast internally to fit the shield supports, which are finally fixed by the locking bolts of the shield. The supports are of forged steel, and are secured in the lugs of the shield, the other ends being secured to right and left-hand side of carriage respectively.

## THE CRADLE.

The cradle is of forged steel of circular section, and is bored internally to carry the gun. Manganese bronze bearing rings are provided on which the gun slides during recoil. Keyways are cut and fitted with bronze liners at the breech end which engage with the keys on the top and bottom of the gun and prevent its rotation during the first part of recoil. On the outside of the cradle are two trunnions screwed and shrunk into the cradle and finally secured by a set screw on the inside. The trunnions are prepared to receive the sight pivots.

## THE TRUNNION BLOCKS. (Plate 9.)

The trunnion blocks are carried on the trunnions of the cradle, the securing arrangements being such that the cradle and blocks may be removed in one piece without dismantling. The trunnion pins are centrally recessed to receive a slightly coned hard steel plug, the outer end of which is formed into a knife edge and rests on a spring bar in the trunnion block. The outer end of the trunnion has its upper half prolonged to give support to the knife edge, whilst allowing clearance for the spring bar at all elevations. The method of support relieves the weight on the trunnions and so reduces friction in elevating. When the gun is fired the anti-friction gear is forced down, and the weight is taken by the trunnions themselves.

The rear end of the spring bar rests on a hard steel bearing piece and the front end on a steel bolt which is capable of adjustment.

To make this adjustment, the bolt must be screwed up hard, *then eased back a quarter of a turn*, and secured by a set screw.

In some ships it has been found that the spring bar "adjusting set screw" does not prevent the "Adjusting Bolt" from easing back. In case of trouble arrangements should be made for new screws with heads to be substituted for the existing headless ones, thus giving a longer slot, and consequently better possibilities of setting up.

(Vide G.O. 182/1915.)

The action of the various parts of the Locking Gear is as follows:—

*The Locking Bolts.*—Slide vertically, one upwards and the other downwards. Each fitted with two projections to engage with corresponding projections above and below in the cheek of the carriage when locked; and with a groove for the stud on the Crank Plate to work in, the locking bolts moving in a vertical direction.

*Crank Plate.*—Circular. Fitted with two studs to engage in grooves in the Locking Bolts, and having a square hole in the middle to take the square end of the Locking Spindle. Its duty is to actuate the Locking Bolts.



*Cradle Locking Stop.*—End fitted to take in hole in cradle when Trunnion Blocks are unlocked, to keep latter in position for locking when the gun is back. Provided underneath with a rack engaging with teeth on the Locking Spindle.

*Locking Spindle.*—Fitted with square end to take into Crank Plate, teeth for actuating Cradle Locking Stop and a Cannelure Groove to receive toe of keep plate and hold spindle in position. Interlocking head with a small notch for spring stop, and a cut-away part to engage head of the Interlocking Register (and struck to the radius of the latter). A nut formed in centre of interlocking head to take the box spanner (three sides flat, one side round. Round part comes on top when "locked").

*Keep Plate and Spring Stop.*—Secures with two screws to face of Trunnion Block. Has a toe engaging in the cannellure of the Locking Spindle, and a spring stop engaging in the small notch in the Interlocking Head when in the unlocked position. A small lever takes in a notch on the end of the spring stop, its other end protruding to the side of the Trunnion Block, so that as the gun runs out, this outer end takes against an inclined plane in the cheek of the carriage, and is forced in, so that the spring stop is withdrawn fully when the Trunnion Block is in position for locking.

*Interlocking Register.*—Ships over a block permanently screwed into the rear face of the Trunnion Block. Kept in place by means of a nut, under which first goes an Indicator Cover Plate keyed to the bolt, and cut away on its lower circumference to disclose the words "Locked" or "Unlocked" as the case may be on the front of the Register. Provided with an arm carrying a substantial hand spring stop bolt to keep the register turned definitely to either "Locked" or "Unlocked." Has a cut-away part struck to radius of Interlocking Head to engage the latter, a groove to interlock with the head of the box spanner when register shows "Unlocked," and a cut-away part struck to radius of box spanner to free the latter when register shows "Locked."

*Box Spanner.*—Removal Rests when in use, and when gun is run back, on a Metal Hook Bracket on the Cradle. Provided with a groove on the under side to interlock with the Register when the latter shows "Unlocked."

To remove the Box Spanner after locking trunnion, it is first necessary to raise hand stop bolt and turn interlocking register to show "Locked." This brings the cut-away part of interlocking register in line with groove on under side of box spanner, and allows it to be unshipped, but at the same time the interlocking register, taking in cut-away part of interlocking head, prevents the locking spindle being moved.

To unlock it is necessary to ship the spanner first, then raise hand bolt and turn interlocking register to show "Unlocked"; this brings the cut-away part in interlocking register directly underneath interlocking head and allows the spindle to be turned and trunnion unlocked, but locks the box spanner to the interlocking head; as the trunnion is unlocked the interlocking head takes in the cut-away part of interlocking register and prevents it being moved.

As the gun is drawn clear of carriage, small spring stop locks the interlocking head and consequently prevents spanner being turned, unless the spring stop lever is actuated.

#### ACTION OF SAFETY ARRANGEMENTS AND REGISTER.

Until the gun is run out, the Locking Spindle cannot turn, for the spring stop is taking in the notch on the Interlocking Head.

Until the Trunnion is locked, the Register cannot be moved, for the circumference of the Interlocking Head is engaged in cut-away part of Register.

Until the Register is turned to "Locked," the Box Spanner cannot be removed, for the circumference of the Register is engaged in the locking groove under the spanner.

When the Register is turned to "Locked," the spindle cannot move, for the circumference of the Register is engaged in the cut-away part of the Interlocking Head.

*On clearing away it is necessary to ascertain that the Register indicates "Locked."*

#### TO UNLOCK THE TRUNNION BLOCKS AND RUN THE GUN BACK.

- (1) Remove the sighting gear.
- (2) Attach to the cradle the small brackets supporting the rear end of the box spanner, and lay the cradle at zero elevation; this brings the holes in the cradle in position to receive the safety bolt.
- (3) Place the spanner on the end of the unlocking screw (this can only be done in one position).
- (4) Pull out the hand operated plunger and swing it round to the unlocked position; this unlocks the operating spindle and locks the box spanner, preventing it from being withdrawn.
- (5) Place the lever on the end of the box spanner, and turn to unlock; this withdraws the locking bolts and shoots forward the safety bolt into the cradle.
- (6) Slack off the rear nut of the hinged bolt and ease out the trunnion block by means of the front nut. When the trunnion block has been withdrawn, by about an inch, the safety pawl will have been freed and the spring plunger will have entered the recess in the operating spindle.

#### RECOIL CYLINDER (Plate 10.)

The Recoil Cylinder is a steel forging secured to the underneath part of the cradle by means of countersunk steel bolts. The shock of recoil is transmitted to the cradle by a thrust rib formed on the upper surface of the cylinder, which engages in a corresponding recess under the cradle and thus prevents the bolts from being sheared. The left side of the cylinder is prepared to receive a bracket carrying the elevating arc, and eye bolts for the attachment of securing chains are fitted to the underside of the cylinder.

The cylinder is recessed in rear to receive the recoil piston, the rear end of the recess being screwed for the reception of the cylinder closing plug.



The front end of the cylinder is recessed centrally to receive the end of the controlling plunger, which steps into the recess from the inside of the cylinder, having a shoulder on it near the front end, and a feather engaging in a corresponding featherway cut in the recess; the front end is screwed for the reception of a nut outside the cylinder which in conjunction with the shoulder inside secures the plunger in position. The plunger is recessed from the rear end up to the shoulder at the front end, which is drilled to afford passage for liquid from the recess to the front end of the cylinder. The passage is obstructed by the plain end of an adjusting spigot screwed into the front end of the plunger from outside, a slight shaving giving the required opening. When the gun is running out the controlling plunger enters a recess in the piston head and compels the liquid imprisoned there to find its way out past the adjusting spigot. If the gun runs out too sluggishly the channel is not free enough, and the shaving on the spigot must be filed down. If, however, the gun runs out too fast, a fresh spigot must be used.

The cylinder closing plug screws into the rear of the recess of the cylinder, and takes against a leather washer, making a watertight joint; the plug is recessed centrally for the piston rod to pass through it, the rear of the recess being screwed to take the inner and outer gland nuts, which with a "U" leather packing prevent leakage past the piston rod.

The "U" leather is kept in its seating by the inner gland nut; the rear surface of the latter is shaped to form the front seating of the packing, and is extended at opposite ends of a diameter to receive the two studs of a hinged collar used for inserting. The rear end of hinged collar is castellated to work in conjunction with a claw spanner.

The outer gland nut forms the rear seating of the packing, and screws on to it, expanding it against the piston rod, so preventing leakage past the rod when there is not enough pressure inside the cylinder to expand the "U" leather.

The piston rod passes through the gland in the cylinder closing plug, the rear end is threaded, and entering a recess in the lug under the breech ring is secured to it with a nut either side; the front end is enlarged to form the piston head and is recessed to receive the controlling plunger, which forms a tight fit inside the recess. A ball non-return valve in the piston head admits liquid from the rear end of the cylinder into the recess during recoil, but confines the liquid in the recess whilst the gun is being run out under the action of the run out springs, compelling it to find its exit to the front end of the cylinder through the hollow controlling ram and past the adjusting spigot.

*Piston Head.*—The piston head has a bronze strip dovetailed into its periphery and secured by suitable rivets. A port is cut in the underneath part of the circumference to fit over the valve key, which controls the recoil.

*Valve Key.*—The valve key is secured to the underside of the recoil cylinder by three circular spigots, which are recessed into the cylinder wall. It is further held in place by three securing bolts passing through the cylinder wall and tapped in to the spigots. These bolts are fitted with tin washers. The valve key is of varying height and working in conjunction with the port in the piston head, so regulates the size of

the opening giving passage to the liquid from the rear end of the cylinder past the piston head, that the tension on the piston rod and consequent strain on the ship's structure, is constant throughout the recoil.

On the right hand rear end of the recoil cylinder is an air hole and at the bottom a drain hole, both being closed by screwed plugs and leather washers. The working recoil is about 16.5 inches and metal to metal 18 inches.

The reserve oil tank is of gun-metal and secured to the right hand side of cradle. The outlet hole to allow the liquid to pass to the recoil cylinder is at the bottom of the tank. A projection on the tank fits into a recess in the recoil cylinder, a leather washer being placed in the recess to form a seating for it, and the joint is secured by a hollow steel bolt screwed down through the hole from the tank into the cylinder, the steel bolt forming the connecting pipe.

There is a hole in the side of the tank, closed by a cap and leather washer for cleaning it out. At the top of the tank are filling and air holes which are closed by screw plugs and leather washers.

#### TO ASSEMBLE RECOIL CYLINDER.

1. Place controlling plunger, put on leather washer and securing nut from outside.
2. Place valve key, and secure it with set bolts.
3. Insert piston, insert L leather packing ring into cylinder plug, screw in inner gland, place leather joint ring, and screw plug into cylinder.
4. Place leather packing, screw in outer gland nut.
5. Run screw collar on to piston rod and secure it by keep screw. Place cross bar (connecting piston rod to run out rods).
6. Run gun out and screw on securing nut on end of piston rod and secure it with set screw.

Instructions for filling the recoil cylinder are found on a brass plate on the mounting.

Care should be taken that all joint leathers are correctly inserted.

#### SPRING CASES AND RUN OUT SPRINGS. (Plate 10.)

The spring cases are steel cylinders, plain inside, and rest in suitable saddle brackets which are securely keyed and bolted to the cradle. The spring cases contain the running out springs, which are of sufficient power to run the gun out at all angles of elevation. The springs are rectangular in section, and each column consists of three lengths of springs, right and left-hand alternately, mounted on a tube and parted from each other by bronze washers sliding on the tube. The rear end of the running out tube is screwed on to a suitable end piece provided with a key, nut and split pin for engaging the lug on the breech ring of the gun. The tube at its front end is provided with a screwed gun-metal bush, into which screws the compression bolt compressing the springs. The arrangement is such that the springs and tubes can be removed or replaced without affecting their initial compression, as



the front compression plate takes against a collar on the compression bolt, and the rear one against a shoulder on the end piece. The compression bolt is prevented from unscrewing by a split pin, and a special tool with capstan handles is provided for screwing it up. The front ends of the spring cases are covered with light brass caps, and the rear ends by screwed bronze end pieces.

#### TO REMOVE A RUN OUT SPRING COMPLETE.

- (1) Run the gun back as previously described.
- (2) Remove split pin and unscrew the nut at rear end of bridge end piece.
- (3) Withdraw springs, tube and compression bolt complete from the front end.

#### TO ASSEMBLE THE RUNNING OUT SPRINGS.

- (1) Place the three springs in line on the deck with the brass discs between them.
- (2) Reeve the running out tube through from front to rear and through the rear compressor plate.
- (3) Enter the compression bolt from the rear and screw up till the collar on the rod bears against the rear end of the running out tube. This gives the correct compression of the springs.
- (4) Place the assembled springs in the case from the front and screw on the rear cap, securing it by set bolt on top.
- (5) Secure rear end of compression bolt to bridge end piece by nut and split pin.

#### ELEVATING GEAR. (Plates 11 to 13.)

*The Elevating Gear* is of the usual rack and pinion type, but Differential gear of the P. VII.\* type is being fitted to some mountings. The toothed arc is attached to the cradle, and the elevating pinion is carried on the left-hand side bar. Stops are formed on the pivot against which the cradle stops at maximum elevation and depression. The actual elevation is read from a graduated scale at the back of the arc.

*Elevating Pinion.*—The elevating pinion and shaft are of steel and forged in one piece. The right-hand end of the elevating pinion shaft is free to revolve inside the gun-metal worm wheel, and is provided with featherways to receive feathers on the inner circumference of a series of steel friction plates. It is threaded at the extreme end to receive the compression nut.

*Worm Wheel.*—The Elevating worm wheel is of gun-metal, and is recessed to receive a series of alternate metal and steel plates, featherways being cut in the side of the recess to receive feathers on the outside of the metal discs.

*Friction Gear.*—In assembling the friction gear, a steel disc is first inserted in the recess, with its feathers engaging in the featherways cut on the shaft, next a metal disc is inserted with its feathers engaging in the featherways cut in the recess in the worm wheel, and so on alternately

until all the discs are inserted; finally, a thick bearing washer and a Belleville spring washer, the whole being bound together with the compression nut, which is hexagonal and has a castellated top; a pin passing through a hole in the end of the shaft and engaging in one of the castellations, prevents the nut from becoming unscrewed.

*Elevating Worm.*—The Elevating worm is of steel, and rides upon the worm shaft with corresponding feathers and featherways. The front end of the worm bears against the casing and the rear end is prevented from moving by a metal bush, which is kept in place by an adjusting sleeve.

*Worm Shaft.*—The worm shaft is of steel. Its rear end revolves in a metal bush carried in an adjusting sleeve which is threaded on the outside and screws into the rear of the casing. This adjusting sleeve is fitted to remove backlash due to wear in the faces of the worm, &c. The head of the adjusting sleeve is hexagonal and carries a serrated flange, a small locking plate preventing the latter from moving out of adjustment. The front end is reduced and passes through a bush formed in the casing, in which it revolves. It is then further reduced and enters the two-speed gear box.

*Two-Speed Gear Box.*—The two-speed gear box is of gunmetal, and contains the Clutch Pinion, Intermediate Pinions, and Driving Bevel Wheel.

*Clutch Pinion.*—The Clutch Pinion is centrally recessed to ride on the worm shaft, the recess having featherways cut in it to receive the corresponding feathers on the shaft. The pinion is capable of sliding along the latter, but is compelled by the feathers to rotate with it. The change of speed is obtained by an internal clutch lever engaging the sliding pinion with the respective gears, the spindle of clutch lever having a small lever fitted externally and operated by hand, radially between stops, which are marked "Fast" and "Slow." The clutch Pinion is of two diameters, the larger having 24 teeth and the smaller 17.

*Intermediate Pinions.*—The intermediate pinions are solid with the intermediate shaft. The high speed pinion has 25 teeth and the low speed 18 teeth. The right hand end of the intermediate shaft is squared to fit the bevel wheel. When the clutch pinion is engaged with the high speed pinion, the speed of elevating is approximately twice that of when engaged with the low speed pinion. With clutch lever to "Fast," one revolution of the handles will elevate the gun  $1\frac{1}{2}^\circ$ , and with the clutch lever to "Slow"  $\frac{3}{4}^\circ$ .

*Elevating Handles.*—The elevating handles are connected by two pairs of bevel wheels and an inclined shaft to the intermediate shaft in the Two-Way Gear Box. The radius of the left hand crank handle is adjustable from 4 to 6.5 inches.

*Firing Mechanism.*—The firing mechanism is contained in the right handle, and is operated by a trigger which closes both main and auxiliary circuits simultaneously. The metal of the two-speed gear box is prolonged out on the right side in the form of a cylindrical boss with a deep annular recess to give ample space between the metal of the boss and the bearing for the right end of the driving shaft, for the necessary wiring.



*Slip Rings.*—An ebonite sleeve is placed over the outside of the boss, a shoulder being left on the left end of the sleeve. Over the sleeve, German silver and ebonite rings are placed alternately, four of each, the shoulder on the sleeve and the ebonite rings being of slightly greater diameter than the German silver rings themselves. An ebonite ring goes on last, and the whole is kept in place by a brass keep plate screwed on to the face of the boss. The keep plate is recessed in the centre to give clearance for the driving shaft and the portion of the handle which engages with it.

Four "C" connections are fitted on the outside of the gear-box casing, clear of all working parts. The two in front are for the leads of the auxiliary circuit to be brought to, and are connected internally to the two outer slip rings on the boss. The two in rear are for the leads of the main circuit to be brought to, and are connected similarly to the inner slip rings on the boss.

*Right Handle.*—The right handle is hollow and recessed on the left to cover completely the slip rings and to make a ring of packing material. The metal of the right, or outer, side of the handle is drawn up inside the recess towards the left, in the form of a stem recessed centrally with featherways to receive the end of the driving shaft with corresponding feathers, whilst a set screw passed through the centre of the handle from the outside into the end of the shaft keeps the handle in place on the shaft.

*Commutator.*—The handle guard carries a trigger with a "pull off" of 6 lbs. When the trigger is pressed a simple system of levers in the handle is operated, and a commutator forced down into the German silver rings. The commutator contains two horse-shoe shaped German silver contact blocks insulated from one another.

These simultaneously complete the circuit between the adjacent rings of each pair, and consequently close the main and auxiliary circuits.

#### ELECTRICAL FIRING CIRCUITS. (Plate 16.)

Main and auxiliary circuits are provided and connect to five-way boxes on the left and right-hand sides of the pedestal respectively. The two circuits are operated through separate contacts by the one trigger on the right crank handle. In addition, a pistol grip is provided and arranged to connect up to the auxiliary circuit.

The run out contacts only provide electrical communications between the terminals when the gun is within 1 inch of the firing position.

The main and auxiliary circuits are both fed from the ship's dynamo firing circuits.

#### THE TRAINING GEAR. (Plates 14 and 15.)

The training gear is operated by a pair of crank handles, the radius of which are adjustable from 4 to 6.5 inches radius. One revolution of the handles trains the gun 1.45 degrees.

The training worm is rotated by the worm spindle, the other end of which is operated by the crank handles through two pairs of bevel wheels.

The worm wheel is of steel and is suspended by two bronze clips, which are screwed in to the bottom of the carriage. Two bronze liners are dovetailed into the inner circumference of the worm wheel and hold it laterally by bearing against the outside of the pedestal. By this means the worm and worm wheel are held in their correct relative position in a vertical direction, and it is possible to raise the pivot without dismantling the training gear.

The training worm and wheel run in an Oil Bath, roughly of "U" section. The inner limb of the "U" is provided with a leather jointing ring which presses lightly against the rim of the worm wheel. The outer limb has a flange for screwing to the cover of the bath. The bath may be emptied of oil, and can then be lowered to enable the worm and worm wheel to be examined. The training worm spindle leaves the oil bath at a gland which is secured to the bath by screws in slotted holes. *Before adjusting the worm clearance these screws should be slackened and carefully tightened again after adjustment to avoid any pinching action of the gland.*

When the worm clearance is adjusted, the worm shaft and bevel pinion "A" are rotated round the bevel pinion "B" (Plate 14).

This is possible because the lower part of casing "C" is free to revolve round the upper part "D." It is secured to it by a steel locking plate "E" and clamped by one bolt on the outside. This bolt must be eased up before the adjustment is made.

The Training Worm is of hard cast phosphor bronze, and is keyed to the worm shaft. It is provided with ball bearings held in brass cage at either end to take the lateral thrust. A pair of steel collars and a steel sleeve hold each cage in its correct position. Lateral adjustment of the ball bearings is effected by a bronze adjusting sleeve at the right-hand end. This sleeve is fitted with a serrated flange into which a locking plate fits, the locking plate being entered from the outside of the worm casing and kept in position by two set screws.

The worm spindle rotates in a bronze bush at either end. The left-hand bush is kept pressed towards the worm by an adjusting bolt which adjusts the worm correctly into gear. A washer under the head of this screw can be adjusted in thickness enabling the best setting of the worm clearance to be repeated after assembling, and this washer can be thinned down if it is desired to set up the worm further. The adjusting bolt is covered by a cap, fitted with a leather washer. Four filling and drain screws are fitted to the worm casing.

*Training Pawl and Stops.*—A bronze bracket is carried from the left sidebar near its attachment to the pivot, and is provided with a square projection with a central hole. In this hole moves a pawl which is forced forward by a spring, but is normally kept back by a trigger handle and retained by a split pin. For the absolute limits of training the square part of the bracket is stopped by bronze stops secured to the pedestal. For use with a semi-permanent stop the pawl is released and the mounting is now stopped by projections which normally pass through a recess in the bracket, but come in contact with the pawl. The pawl also assists to secure the mounting when not in use, by means of a "housing" stop.



*Training Index.*—A training racer and index indicate the angle of training to the port or starboard side, the graduations being of colour appropriate to the side. The index is illuminated at night. The training stops and racer are constructed for each separate mounting by the shipbuilders in accordance with the conditions obtaining in the ship for that particular location of mounting.

#### PERCUSSION FIRING GEAR (MECHANICAL). (Plate 32.)

The mechanical firing gear is very similar to that described (with sketch) under P. IX. Mounting, the gun portion being common for all Mark XII. Guns.

It is actuated by a foot pedal on the left (gunlayer) foot rest. A spring mounted on the portion of the rod near the pedestal is always tending to keep the gear in the ready position.

The gear is adjustable by means of a screwed sleeve close to the spring, and the safety arrangements are those described under P. IX. Mounting.

#### SEATS.

Adjustable seats and foot-rests are provided, carried from the carriage on either side of the mounting, to allow the gunlayer and trainer to operate the elevating and training gears.

### CHAPTER III.

#### THE P. VII.\* MOUNTING.

##### 6-INCH P. VII.\*

The principal differences between this mounting and the P. VII. are :—

- (1) The maximum elevation is increased to 20° in Mountings Nos. 48 to 59.
- (2) Initial load on running out springs is increased to 10,000 lbs. in these mountings, to take the gun out at the increased elevation.
- (3) The Trunnion Blocks are of a modified pattern, containing roller bearings.
- (4) A position is provided for an auxiliary Gunlayer, differential elevating gear being fitted.
- (5) Arrangement of electric firing gear is modified, in Mountings after No. 38.
- (6) A spray shield only is fitted.
- (7) Director Firing gear is fitted to Mountings, Nos. 48 to 59.

*All parts of this Mounting which are common to the P. VII. are described under that Mounting, and include*

*Recoil and Running out Arrangements,  
Training Gear,  
Percussion Firing Gear,  
Pivot Lifting Gear.*

#### TRUNNION BLOCKS. (Plate 22.)

The Blocks themselves are similar to those described under P. VII. mounting with the substitution of a roller-bearing for the knife edge and spring bar. The locking arrangements and the method of unlocking to run the gun back are as described under that mounting.

The roller bearing consists of 23 rows of steel rollers, two rollers in each row. The rollers revolve between hard steel racers in a brass cage, being kept in position by three wires sprung into grooves in the cage.

The trunnions are steel forgings screwed and shrunk into the cradle and secured from rotating by a set screw. Hard steel sleeves are fitted over the trunnions and rest in the roller bearings.

The trunnions are prepared to receive the sight pivots.

#### ELEVATING GEAR. (Plates 19 to 21.)

The gun can be moved in elevation by the gunlayer, by the auxiliary gunlayer, or by both. The gunlayer is seated on the left of the mounting, in a suitable position for using his telescope, and is provided with a pair of crank handles. The auxiliary gunlayer stands in rear and keeps the gun roughly on for elevation by means of a large elevating wheel, using an open sight. The crank handles and elevating wheel transmit by rod and bevelled gearing to differential gearing, by



means of which the elevating pinion is rotated. This pinion is carried on the left-hand side bar, and gears in a toothed elevating arc attached to the cradle.

Stops are formed on the pedestal against which the cradle stops at maximum elevation and depression. The actual elevation is read from a graduated scale at the back of the arc.

The Differential nature of the gear makes it possible for the gunlayers to act conjointly, and also takes the place of frictional gear as fitted in earlier mountings.

The gunlayers' crank handles are exactly the same as those described under the P. VII. Mounting. The left handle is adjustable from 4 to 6.5 inches radius, and the right handle carries the firing gear.

The Two-speed elevating gear, as described under P. VII. Mounting, is fitted between the crank handles and the Differential gear box. With clutch lever to "Fast," one revolution of the handle will elevate the gun  $1\frac{1}{2}^\circ$ , and with clutch lever to "Slow"  $\frac{3}{4}^\circ$ .

*Differential Gear.*—The differential gear consists of two worm wheels and worms connected by means of bevel gearing to a centre piece keyed on to the pinion spindle. The rotation of the centre piece due to either of the worm wheels being revolved separately or simultaneously elevates or depresses the gun. One worm is connected through the Two-speed gear box to the elevating handles operated by the gunlayer; the other worm is operated by the auxiliary gunlayer's wheel. The main elevating worm is left-handed, and the auxiliary elevating worm is right-handed, both worms being provided with ball bearings to take the lateral thrust. The worms and ball bearings are kept in position on their respective shafts by a screw adjusting sleeve A at one end. The heads of these sleeves are hexagonal and carry a serrated flange, a small locking plate preventing the latter from moving out of adjustment.

#### TO ASSEMBLE DIFFERENTIAL ELEVATING GEAR. (Plate 19.)

In some mountings the elevating pinion is solid with its shaft, and in consequence the elevating gear cannot be assembled until the gun and cradle have been run back.

#### *Method of Assembling Gear.*—

- (1) Insert elevating pinion and shaft in its bracket from the inside.
- (2) Place on the shaft the left-handed worm wheel from the outside, followed by the centre piece carrying the bevel pinions.
- (3) Place the right-handed worm wheel on the shaft, and secure the whole in place by washer, screwed sleeve and split pin.
- (4) Engage auxiliary worm (right-handed) in its worm wheel, placing the Hoffman ball bearings in place at each end. (The worm and bearings can be kept in place by screwing up the end adjusting sleeve.)
- (5) Insert auxiliary worm shaft through the worm, ball bearings and small bevel pinion, securing small bevel pinion by washer and set screw.
- (6) Place large bevel pinion and large spur wheel in place.
- (7) Put on the cover, and secure auxiliary Gunlayer's wheel in place.
- (8) Screw up adjusting sleeve until the auxiliary worm will revolve its wheel without backlash.

In the P. VII.\* mounting, the shaft connecting the front elevating gear to the Differential gear is in one piece, and so the front bracket must be unshipped before the shaft can be placed.

In the P. XIII. and XIII.\*, the shaft can be parted in the centre, so either part of Elevating gear can be assembled separately.

The main elevating worm (left-handed) is assembled in the same way as the auxiliary. The small pinion is then placed in position on the end of the worm shaft, and secured by washer and set screw. Then engage large pinion in the small one, and slide front bracket and main shaft rearwards until end of shaft is engaged in large pinion.

The cover can then be put over these two pinions and the front bracket secured. Screw up the adjusting sleeve until the main worm will revolve its wheel without backlash.

#### FIRING GEAR (ELECTRICAL). (Plate 23.)

The electrical circuits of Mountings Nos. 1 to 38 are identical with those of the P. VII. Mounting, and are described with diagram under that mounting. (Plate 16.)

In Mountings Nos. 39 to 47 the circuits on the mounting are as already described under the P. VII. Mounting.

In addition, an alternative source of supply is provided by secondary batteries carried on the mounting. For this purpose a battery change-over switch is provided and fitted on the left-hand side of the mounting, by means of which either of the above sources of supply may be connected up.

In Mountings Nos. 48 to 59 the circuits are modified to suit Director Firing, which is fitted to these mountings.

The gun is arranged to be fired electrically by means of a trigger on the inner elevating crank handle. Main and auxiliary circuits are provided, which are operated through separate contacts by one trigger. In addition to the above, a pistol grip is provided. Interceptor contacts are provided and fitted on the right-hand side of the mounting. These contacts only provide electrical communication between the terminals when the gun is within 1 inch of the firing position, and are arranged so that the lower contact drops when the gun recoils, and has to be replaced by hand before the gun can be fired.

Current may be taken from the ship's dynamo circuit or from batteries carried on the mounting. For this purpose a battery change over switch is provided and fitted on the left-hand side of the pedestal, by means of which either of the above sources of supply may be connected up. For "Director Firing," a change over switch is fitted on the right-hand side of the mounting, through which the current passes to the interceptor contact and by means of which "Director" or "Individual firing by battery" may be used.

Six-way connections are provided, from which the current is distributed to the firing and night sight circuits.



### SPRAY SHIELD. (Mountings Nos. 1 to 38.)

The spray shield is carried on the carriage, and is of steel plate fitted with a canvas cover over the gun port.

### SPRAY SHIELD. (Mountings Nos. 39 to 59.)

The spray shield is carried on the carriage, and is of steel plate fitted with a canvas cover for the gun port. Covers for the sight ports are also provided for use when the gun is not in action. They are secured by thumb screws so as to be readily detached.

## CHAPTER IV.

### THE P. IX. MOUNTING. (Plates 24 to 34.)

The mounting consists of a pedestal; a pivot and carriage, to which is attached a shield; and a cradle.

#### THE PEDESTAL. (Plates 25 and 26.)

The pedestal is of forged steel, having a circular base which is secured to a steel packing ring by twenty 1.875 inch diameter bolts. The pedestal is recessed to take the training rack and pivot of the carriage.

Two metal bushes, the upper one being flanged, are provided at the top of the pedestal, and forms bearing surfaces between the pedestal and the training rack.

Near the base of the pedestal there are two bushes; the lower one is of metal and the upper one of hardened steel. The latter provides the bearing surface for the lower vertical roller ring which consists of a number of rollers held in a cage of manganese bronze.

Above the lower vertical roller ring the pedestal is cupped out to take the hand clamping gear, which is arranged to grip the lower portion of an extension of the training rack.

At the base is a horizontal roller bearing on which the training mass revolves. This roller bearing tray is contained in a manganese bronze bearing tray fitted to slide in and out of the pedestal from the rear when required for examination.

A lubricating hole is provided in the side of the pedestal for lubricating the inner bearings. This is closed by a screwed plug.

Two holes are tapped in the sides of the pedestal, opposite each other, for lifting bolts.

#### THE TRAINING RACK.

The training rack is of steel and fits inside of and on the flange of the upper bearing bush on the pedestal. It is in four diameters externally; one for the teeth of the training rack, two for the upper bearing bushes, and the fourth for the band brake. The training rack can be clamped to the pedestal by means of the band brake, and if the latter is eased back it is free to revolve inside the pedestal. On the inside at the top a hardened steel bush is secured which forms a bearing surface for the upper vertical roller ring; below this bush a metal bearing bush is secured.

#### THE TRAINING CLAMP.

The training rack can be clamped to the pedestal by means of a band brake, holes being bored in the pedestal to receive the hinge bolt and the clamping bolt and nut; the clamping nut is operated by a ratchet lever and a stop stud is screwed into the pedestal at each side of the ratchet lever, to prevent undue motion of the latter.



The band brake should be set up so as to hold the training rack sufficiently rigid to allow the mounting to be trained by the hand wheel. If, however, any undue strain should be brought on the gun or cradle the band brake will render, and thus prevent any damage being done to the training gear.

#### THE CARRIAGE.

The carriage is of forged steel in the form of a "Y" bracket, recesses being formed in the inside of the side cheeks to take the trunnion blocks, the latter being so constructed and arranged that the gun may be run inboard by deck bogies in the usual manner.

Provision is made on the rear face of the right-hand trunnion block for taking the bracket carrying the director training receiver and driving gear.

To the outside of the side cheeks two steel bars are bolted for the purpose of carrying the elevating bracket, seats, etc. The side bars are closely fitted into the sides of the carriage, and are forced in by hydraulic power.

The weight of the carriage and pivot is taken on the roller bearing in the base of the pedestal, and the pivot is supported horizontally by two roller rings.

Lubricating pipes are led through the training rack to the pivot bushes.

#### SHIELD. (Plate 27.)

A shield is attached to the carriage by four supports.

The shield is 80 inches in diameter and of nickel steel 2.94 inches thick. It is grooved on the inside for fitting to the dovetailed ends of the shield supports. Screwed holes are inserted in the top of the shield, one on each side for lifting eyebolts. These screwed holes are closed by preserving screws. An additional shield hood and mantlet plate (the latter being carried by stays from the front end of the cradle) is fitted. The arrangement of the shield hood and mantlet plate is such that the gun aperture in same is almost entirely closed at all positions of elevation and depression of the gun.

Blast screens are fitted to the front and sides of the carriage to protect the sightsetters.

#### CRADLE. (Plate 28.)

The cradle is of forged steel of circular section, and is bored out to carry the gun. Manganese bronze bearing rings are riveted into the front and rear ends of the cradle to form bearings for the gun. These rings are grooved for lubricating purposes. The rearmost set of bearing rings has a keyway at the top and bottom to suit the keys on the gun. On the outside of the cradle are two trunnions securely screwed and shrunk into the cradle. Angle plates are bolted on to the front end, to which is secured the mantlet plate.

Besides supporting the gun, the cradle carries the recoil cylinder, running out spring cases, elevating arc, sighting gear, etc.

#### THE TRUNNION BLOCKS. (Plate 29.)

The trunnion blocks are carried on the trunnions of the cradle, and are prevented from slipping off by means of small keep plates which are screwed on to the outside of the trunnions. The locking block is carried on a spindle, to which it is attached by a feather and featherway and provides the means of locking the block to either the cradle or the carriage.

The bearing of each trunnion consists of a cage of steel rollers between two hardened steel bushes.

The locking block spindle has a small hole recessed in the outer end into which the upper spring bolt fits; this latter locks the spindle when the locking bolt is locked to the cradle, and the action of running the cradle out into the carriage releases the stop. On the rear end of the spindle there is a segment of a bevelled pinion attached to it by a feather and featherway, and its teeth engage into the teeth of a segment of a bevelled pinion carried on a ring which works on the external circumference of the outer hardened steel bearing. On the other side of this ring is a slotted projection and engaging in this slot is a metal slide block; this slide block is connected by a screwed pinion to a cranked lever and on the other end of this crank lever the locking lever can be shipped; a screwed bolt takes in a groove cut in the crank lever and prevents it from moving longitudinally. The locking lever can only be shipped or unshipped when the trunnion blocks are locked to the carriage; a stud on the lever is then in line with a groove cut in the trunnion block. When the lever is pushed home this stud is in line with a circular groove which allows the locking lever to be revolved.

A tongue on the locking lever operates the lower spring stop and when the lever is unshipped this stop fits into a recess in the crank lever, thus preventing the trunnion block from moving.

The locking lever when shipped is attached to the crank lever by means of a tongue, the former engaging in a groove in the latter. A hole is drilled in the rear face of the block to enable the lower spring stop to be removed and is closed by a brass closing plug.

At the rear end of the trunnion block are the usual fittings for the running out screws and starting screws. The locking gear of all trunnion blocks are to be lubricated and worked at least once a week to ensure their remaining serviceable.

(Vide Gunnery Orders 49 and 130 of 1916).

#### RECOIL CYLINDER. (Plate 30.)

Is the same in all respects as that described under P. VII. Mounting.

#### SPRING CASES AND RUN-OUT SPRINGS. (Plate 30.)

The spring cases are steel cylinders, plain inside, and secured to the top of the cradle by means of gunmetal brackets at the front and rear ends.

The spring cases contain the running out springs, which are of sufficient power to run the gun out at all angles of elevation.

The spring case caps are of gunmetal and are screwed into the rear end of the spring cases and secured by set screws.



The spring cases contain the running out springs, which latter are of steel and of rectangular section, three springs in each case. At the front end of the springs a steel compressor plate is placed, and between each spring a gunmetal disc.

The running out tube is of steel, threaded externally at its front end to take the front compressor plate and internally at its rear end to take the screwed bush for the running out rods.

The running out rods engaging with the screwed hole through the bush, compress the springs. The arrangement is such that the springs and tubes can be removed or replaced without affecting their initial compression.

The running out rods are secured to the crosshead bracket which is fixed to the top of the breech lug of the gun.

#### ELEVATING GEAR. (Plate 31.)

The elevating gear is of the usual rack and pinion type. The main elevating bracket is carried at the rear of the left-hand side bar of the carriage, and consists of a gunmetal bracket suitably arranged to take the elevating director gear.

The internal gear consists of the pinion shaft carrying the pinion which gears with the elevating rack, together with the worm and worm-wheel, friction gear (consisting of alternate washers of steel and bronze), clutch shaft, bevel gears, and large handwheel (for use with the director gear).

Ball thrust bearings are fitted at each end of the elevating worm and adjustment is made by an adjusting bush at the rear end of the worm. Suitable oil plugs are fitted to the elevating bracket where required, and a drain plug to the lowest part of the worm chamber.

The elevating worm shaft couples up to the bracket secured to the underside of the carriage on the front left-hand side. This bracket contains a two-speed gear worked through a change speed lever carried from the bottom of the bracket. The fast and slow speeds give respectively  $1^\circ$  and  $\frac{1}{2}^\circ$  elevation of the gun per revolution of the handles. An intermediate elevating shaft transmits motion to the speed gear box from the elevating handle bracket. This latter is fixed on the left-hand side bar and contains a steel bevel wheel and pinion, which transmits motion from the elevating handles. The elevating handles have radial adjustment from a minimum of 4 inches to a maximum of 6.5 inches. The right-hand elevating handle carries a trigger which, through suitable levers, operates the firing contacts in the contact box.

The elevating arc is of steel and is secured to the cradle at its upper end, and at its lower end to a bracket which in turn is securely screwed to the recoil cylinder.

The elevating arc is engraved on its side face from  $14^\circ$  elevation to  $7^\circ$  depression. A pointer bracket is attached to the rear end of the side bar and is in close contact with the degree markings on the elevating arc.

#### THE AUXILIARY DIRECTOR ELEVATING GEAR.

An auxiliary elevating wheel is keyed to the shaft carrying the elevating worm by a moveable key.

This wheel is for laying the gun in director firing, and when not in use the clutch lever should be put to "free." When director elevating gear is in use, the gunlayer's speed clutch must be put in central or neutral position.

The director elevation receiver is mounted above this wheel, the mechanical pointer being worked by a split pinion moving over a special elevation arc.

#### FIRING GEAR (ELECTRIC). (Plate 34.)

Electric firing is fitted and the firing cables are in duplicate. The main circuit is operated by means of a trigger on the right handle of the elevating gear, which is situated on the left-hand side of the mounting. The auxiliary circuit is operated from a pistol grip placed immediately below the elevating handles.

Rheostats, five-way connection pieces and dial lamp switches are fitted.

The box contacts are fitted at the breech end and are arranged so that the gun can be fired one inch from the complete run out position. Buzzers are fitted in connection with the firing circuits.

#### DIRECTOR FIRING CIRCUIT.

The director firing circuits, main and auxiliary, are led to a change over switch situated between the contact box and the run out contact. When this switch is over to "Director" the gunlayer's main and auxiliary circuits are both cut out. The same safety arrangements for "Breech" and "Gun out" are thus used in "Director firing" as in "Individual firing."

#### PERCUSSION FIRING GEAR (MECHANICAL). (Plate 32.)

The mechanical firing gear consists of a series of rods and bell crank levers actuated by a foot pedal on the left (gunlayer's) footrest. A spring, mounted on the foot-pedal rod, is always tending to keep the gear in the ready position. A telescopic joint is fitted at A, which allows for the movement of the gun in elevation. The gear is adjustable by means of a screwed sleeve at B. On the pedal being pressed, the rod A is revolved in a counter clockwise direction, which causes C to be pressed to the left, and thus by a system of bell cranks D is moved to the right. Rod D presses in on E and by means of a bell crank lever F moves G to the rear. Engaging in G is the trigger bar H, which is pivoted on the sear (see woodcut).

#### SAFETY ARRANGEMENTS.

*The gun cannot be fired until it is properly run out, C being disengaged from H until the gun is in the out position.*



*The gun cannot be fired until the breech is properly closed. Cam plate K bears against D until the breech is properly closed, i.e. until E is in line with D.*

*The gunlayer cannot keep the pedal pressed whilst the breech is being worked. The cam plate K forces D to the left, thus placing pedal in the ready position. The underside of D is bevelled off to enable it to ride on the cam K when closing the breech.*

#### THE TRAINING GEAR. (Plates 25 and 33.)

The training gear is operated by double handles of a similar type to that of the elevating handles. They are adjustable from a minimum of 4 inches radius to a maximum of 6.5 inches radius. One revolution of the handles trains the gun  $1\frac{1}{2}^\circ$ .

The training rack is of steel and is frictionally secured to the pedestal by means of the clamp. The training rack and manganese bronze worm are completely protected by a casing, which forms an oil bath, extensions of which form the worm box and training shaft casing. The training worm is keyed to the training shaft and is provided with ball bearings at each end to take the longitudinal thrust. The training shaft, worm and ball bearings are mounted in a steel cage, which is supported in the worm box on the right by a spherical bearing. The spherical bearing is held in place by a collar and nut, the nut being prevented from unscrewing by a set screw. (Plate 25.) Flats on the cage and on the inside of the worm box keep the left side of the cage in position. The left end of the worm box is closed by a screwed cover, inside which is fitted an adjusting nut. This nut forms an adjustment for the ball bearings and is prevented from unscrewing by a set screw on its perimeter, which screws in parallel to the axis of the shaft. To take up backlash between the worm and training rack a bolt is provided. This bolt, with a plain end, is screwed horizontally through the worm box and bears against the left end of the cage, thus pressing it and consequently the worm towards the training rack. A spring is fitted round this bolt and maintains a constant pressure between worm and rack. The spherical bearing allows the necessary adjustments to be made for backlash without bringing any undue strain on the gear.

A bevelled pinion is keyed on the right end of the worm shaft and is driven by a series of wheels from the training handles. The oil bath is filled through a plug fitted to the top of the training worm bracket on the left. Overflow and drain plugs are also provided. Lubricating pipes are led from cups on the training worm bracket, in order to lubricate the pivot bushes.

#### THE DIRECTOR TRAINING GEAR.

The director training gear is carried on the right side of the carriage in rear, for training the mounting when in director firing. A clutch is fitted alongside the trainer's seat to put the director training wheel in or out of gear. This clutch, when in, keys the bevel wheel connected to the director training shaft to the intermediate shaft from the trainer's handles. The trainer's handles can be put in or out of gear by the clutch.

#### SEATS.

Adjustable seats and footrests are provided, carried from the carriage on either side of the mounting, to allow the gunlayer and trainer to operate the elevating and training gears.

## CHAPTER V.

### THE P. XIII. AND XIII.\* MOUNTINGS.

#### P. XIII. AND P. XIII.\* (Plates 35 to 43.)

The P. XIII. Mounting carries a cast steel shield and the P. XIII.\* a spray shield.

In all other particulars these two mountings are identical.

The principal differences between this mounting and the P. VII.\* are:—

- (1) The maximum elevation is increased to  $30^\circ$ .
- (2) Initial load on running out springs is increased to 12,170 lbs. to take the gun out at the increased elevation.
- (3) The arrangement of pivot support is different, and no lifting gear is fitted.
- (4) Elevating Handwheel is fitted instead of crank Handles.
- (5) Training gear is of a new pattern.
- (6) Electrical circuits and Percussion firing gear are modified.
- (7) Director gear and Evershed's Bearing Receivers are fitted.
- (8) No seats are provided for the Gunlayer or Trainer.

*All parts of this mounting, which are common to the P. VII.\*, are described under that mounting. The Trunnion Blocks are described under the P. VII.\* Mounting, and the method of unlocking the trunnions and running the gun back is described under the P. VII. Mounting. Recoil and Running out arrangements are described under the P. VII. Mounting.*

#### THE PEDESTAL AND CARRIAGE. (Plate 39.)

The pedestal is of forged steel, having a circular base plate which is secured to a steel packing ring by twenty-four 1.75 inch diameter bolts. The upper face is prepared for the reception of the training bevel wheel, which is secured to it by keys and screws.

The interior of the pedestal is recessed and provided with a hardened steel bush at the top and bottom. These bushes form the outer races for the roller bearings supporting the carriage pivot.

The interior floor of the pedestal is prepared to receive the lower race of the footstep ball bearing, which supports the weight of the revolving mass.

A shoulder is formed on the lower part of the pivot, and rests on the upper race of the ball bearing.

No cage is provided for the balls. The ball bearing is lubricated by lubricators suitably placed outside the pedestal, which also lubricate the lower roller bearings.

For the purpose of examination two hand holes are provided directly opposite one another through the pedestal wall. These holes are closed with watertight brass covers.



The lower face of the pivot shank is provided with tapped holes for securing a flanged tube which carries on its lower end the gearing for operating Evershed's Bearing Indicator.

When it is desired to lift the pivot, this flanged tube can be withdrawn by slackening the securing bolts from below the deck.

The shank of the pivot is made hollow, and is closed at its upper end with a waterproof screwed gland plate through which the whole of the electric cables leading to the mounting are passed.

\* The pivot is supported laterally in the pedestal by an upper and lower roller bearing.

*Roller Bearings.*—The shank of the pivot is provided with two hard steel sleeves shrunk on, which form the inner race for the upper and lower roller bearing. The roller bearings consist of a bronze cage, carrying two rows of rollers, the rollers being staggered in a vertical direction. The rollers are kept in position by three spring steel wires, which rest in grooves turned in the roller cage and prevent the rollers from falling out.

In order to facilitate the examination of the roller bearings a collar in two pieces is secured to the pivot shank immediately underneath the upper bearing with the object of raising the cage with its rollers out of the housing in the pedestal. Special shoulders are provided on the pivot to prevent undue longitudinal movement of either the upper or lower roller cages.

The upper roller bearing is lubricated by a lubricator in front of the pivot and through oil holes in the bottom of the gap between the pivot cheeks. The lower roller bearing is lubricated by the same lubricators as the footstep ball bearing.

#### INSTRUCTIONS FOR RAISING PIVOT FOR EXAMINATION OF FOOTSTEP BEARING.

- (1) Slack away the electrical cables under the deck.
- (2) Remove the bolts under the deck securing Evershed's Bearing Receiver Gear.
- (3) Remove the bolts, which secure the lower half of Training Wheel Oil Bath to the cover.
- (4) Remove front section of cover by means of special tool.
- (5) Withdraw Training worm wheel bracket until bevel pinion is clear of bevel wheel (as described under training gear).
- (6) Remove pedestal handhole covers.
- (7) Pivot can then be jacked up.

By inserting the hand into the handhole, the balls can then be removed one at a time. A ring is fitted round the inside of the balls and a ledge on it projects under the lower ball race.

This ring prevents the balls dropping down inside the pedestal and has several holes in its upper edge.

When the pivot has been removed, the ball races can be lifted out of the Pedestal by inserting a long piece of wire, with a hook on the end, into one of the holes in this ring.

The ring and ball races can then be lifted out of the Pedestal.

#### ELEVATING GEAR. (Plates 19 to 21.)

The elevating gear is of the differential type, and is very similar to that fitted in the P. VII.\* Mounting.

The elevating pinion is carried on the left-hand side bar, and is rotated by means of the differential gearing.

This gearing is described with plates in description of P. VII.\* mountings, and can be operated by the gunlayer or auxiliary gunlayer. It also takes the place of "frictional" elevating gear as formerly fitted.

The elevating handwheel is situated near the trunnions in a convenient position for the telescope eyepiece, and elevates the gun through two pairs of bevel wheels carried in a gear box attached to a plate carried by the left-hand side bar. The shaft passing rearwards to the differential gear box is in two pieces joined together by a keyed coupling so that either the front or rear gear boxes can be taken down without disturbing the other. To disconnect the coupling the two screws are removed, and the coupling can then be slid rearwards, thus breaking the connection.

The auxiliary layers handwheel is carried by a spindle which rotates in bearings in the differential gearbox, the auxiliary gunlayer directing his operations by means of a rough open sight carried immediately over the sighting telescope.

The following speeds of elevating gear are arranged, viz. :—

Gunlayer's handwheel, 1 degree per revolution.

Auxiliary layer's handwheel, 2 degrees per revolution.

There are 3 adjustable sleeves to take up backlash and lateral thrust. These are similar to those described under the P. VII.\* Mounting.

#### PERCUSSION FIRING GEAR (MECHANICAL). (Plate 42.)

The gun portion is common to all the mountings for Mark XII. guns. Owing to wheel elevating gear being fitted in this mounting, the rod gearing is carried entirely by the cradle, instead of by the pedestal.

A gun-metal bracket is secured to the front of the cradle, passing round the front end of the carriage and projecting rearwards, forming at its extremity a handgrip for the gunlayer. The trigger which is contained in the handgrip operates by means of rods and levers a torsion shaft which runs longitudinally along the cradle and carries at its rear end a tappet lever engaging a suitable lever mounted upon the breech ring of the gun. This tappet lever is bevelled off so as to engage the lever on the gun with certainty when the gun runs out after recoil in any position of the firing trigger. The torsion shaft is in two parts for convenience in dismantling, and is supported by a bracket at the rear end of the cradle and also by an intermediate bracket about half-way along its length. The front bracket is dismountable for the purpose of enabling the cradle to be run to the rear.

Backlash in the gear can be taken up by an adjustable screw with lock nut provided near the trigger and accessible by removing the trigger with its axis pin and the screwed cap adjacent. Lubricators are provided at all the important points.



## TRAINING GEAR. (Plates 40 and 41.)

The training gear consists of a steel bevel wheel in the form of a ring attached to the upper face of the pedestal by keys and screws.

No training clamp is fitted, but the training gear itself is frictional.

Engaging in the steel bevelled ring is a steel bevel pinion D, which is rotated by the crank handles. The bevel pinion is a solid forging with its shaft and rotates in horizontal bearings formed in a composite bracket consisting of two parts, the one of steel attached to the pivot and the other of bronze attached to the steel bracket. The bronze bracket carries the worm wheel and its gearing.

The steel bracket forms a bearing for a large bronze sleeve C keyed to the pinion shaft. This sleeve is made slightly larger than the extreme diameter of the bevel pinion so that the pinion can be withdrawn into the bearing in the steel bracket when it is desired to lift the pivot.

To do this, the four bolts GG securing the bronze bracket to the steel one must first be moved. A special screwed stud is then screwed into the lower hole in place of the bolt. The bronze bracket and pinion shaft can now be withdrawn about 3 inches, the weight being taken by the special stud. The bevel pinion will then be clear of the bevel wheel.

The bevel pinion D is rotated by means of a worm and worm wheel, the worm wheel being secured to the pinion shaft by means of a friction clutch. Six steel washers are keyed to the shaft and six bronze washers to the worm wheel, and are pressed together by two Belleville washers, collar and screwed nut.

The worm is rotated by means of a pair of crank handles and a bevel wheel and pinion, carried in a separate bracket mounted in the bronze worm wheel bracket. The radius of the handles is adjustable from 4 to 6½ inches.

The worm bracket is supported on two pivot pins FF, which are made tapered so as to be accurately adjusted and secured by two lock nuts.

If any backlash develops between the worm and worm wheel, the whole bracket and worm can be rotated slightly about these two pivot pins, thus pressing the worm into closer gearing with the worm wheel.

This adjustment is made by a bolt A, secured with a lock nut, fitted on the outside of the worm bracket.

The thrust of the worm is taken on thrust washers and leather joints are provided so that the worm wheel casing can be kept partially filled with oil. A filling plug and drain plug are provided for the purpose of lubrication.

Should backlash develop between the bevel pinion and the main bevel wheel at the top of the pedestal, an adjustment is provided as follows:—

The inner face of the bronze worm wheel bracket is provided with a screwed spigot on which is screwed a strong steel collar B. This collar butts against the steel bracket and so limits the amount that the 4 bolts can pull the bronze bracket and pinion shaft towards the pivot.

To adjust, therefore, the clearance between the pinion and bevel wheel, the 4 bolts are removed, leaving the worm wheel bracket supported by the 4 spigots on the steel bracket. The screwed collar B can then be rotated counter clockwise the desired amount by a claw spanner. The 4 bolts are then re-inserted, and the bronze bracket can now be pulled harder up than before, and thus allow the bevel pinion to gear more closely into the bevel wheel.

The rate of training is 1 degree per revolution of the handles.

## METHOD OF ASSEMBLING TRAINING WORM BRACKET.

- (1) Place right-hand adjusting bush in bracket and screw right in.
- (2) Put plain thrust washers in bracket.
- (3) Place one of the keyed thrust washers on top of worm and place in bracket.
- (4) Thread worm shaft through bracket and worm.
- (5) Place second keyed thrust washer at bottom of adjusting collar, and screw adjusting collar on to worm shaft.
- (6) Place locking plate over worm shaft in suitable position to engage set screw.
- (7) Thread bevel wheel over worm shaft.
- (8) Screw in left-hand adjusting bush.
- (9) Screw nut on worm shaft and secure bevel wheel.
- (10) Place distance piece and bevel pinion between adjusting bushes.
- (11) Thread spindle through left-hand side of bracket through distance piece and bevel pinion.
- (12) Adjust bevel pinion by means of bushes.
- (13) Place handles on spindle.
- (14) Secure worm bracket cover, thus locking adjusting bushes.

The complete bracket can now be put into worm wheel bracket, whether worm wheel is in position or not.

## TRAINING PAWL AND STOPS.

A steel bracket is carried from the left side bar near its attachment to the pivot and at the lower end of this bracket is secured the training pawl bracket, which is provided with a square projection with a central square hole. In this hole moves a pawl which is forced forward by a spring, but is normally kept back by a trigger handle and retained by a split pin. For the absolute limits of training the square part of the pawl bracket is stopped by bronze stops secured to the pedestal. For use with a semi-permanent stop the pawl is released and the mounting is now stopped by projections which normally pass through a recess in the pawl bracket, but come in contact with the pawl. The pawl also assists to secure the mounting when not in use, by means of a "housing" stop.



## TRAINING RACER.

A training racer for indicating the angle of training to port or starboard is attached to a circular plate and angle structure built round the pedestal; this structure which is provided with an upper surface of chequered steel plate forms a path for the gunlayer and trainer. The training index is carried from the sight setter's platform by means of a stiff tube, and in order to enable the pointer to adapt itself to slight inaccuracies in the racer it is formed as part of a hinged bracket provided with a small roller. The index is illuminated for night use. Training stops and racer are constructed for each separate mounting by the shipbuilders in accordance with the conditions obtaining in the ship for that particular location of mounting.

## SHIELD. (P MARK XIII.)

A cast steel armour plate is fitted varying from 2.75 inches thick at front to 1.1 inch thick at the rear. Suitable recesses are cast internally to fit the shield supports which are finally fixed by bolts. Suitable openings for gun and sight ports are arranged, the gun port being fitted with a canvas cover. Two bosses are cast on the underside of the roof and screwed to take the place of these lifting eyes when not in use.

## SHIELD SUPPORTS.

Steel supports of "U" shape fitted and secured at outer side in lugs of shield, the inner side being secured to the pivot carriage.

## SPRAY SHIELD. (P. MARK XIII.)\*

The spray shield is carried on the carriage, and is of steel plates and angles fitted with a canvas cover for the gun port. Covers for the sight ports are also provided for use when the gun is not in action. They are secured by thumb screws so as to be readily detachable.

## ELECTRIC FIRING GEAR. (Plate 43.)

The gun is arranged to be fired electrically through a change over switch either from a director firing position or through main and auxiliary pistol grips controlled by the gunlayer. The Director firing leads pass through the centre of the pivot directly to the change over switch. For individual firing, two firing leads, main and auxiliary, are brought up through the centre of the pivot to battery change over switches on the mounting, and, in addition, main and auxiliary battery boxes containing secondary cells are secured to the sightsetter's platform. From the battery change over switches the cables are led to two six-way connections, main and auxiliary. The whole of the lighting circuits and the auxiliary firing circuits are run from the auxiliary six-way connection, the main six-way supplying the main firing circuit only. In order to enable the auxiliary electric supply to be utilised in the main circuit, a change over switch is placed between the auxiliary battery change over switch and the auxiliary six-way connection.

Interceptor run out contacts are provided and are fitted on the right-hand side of the mounting through which the current passes to the safety contact on the breech mechanism and thence to the striker.

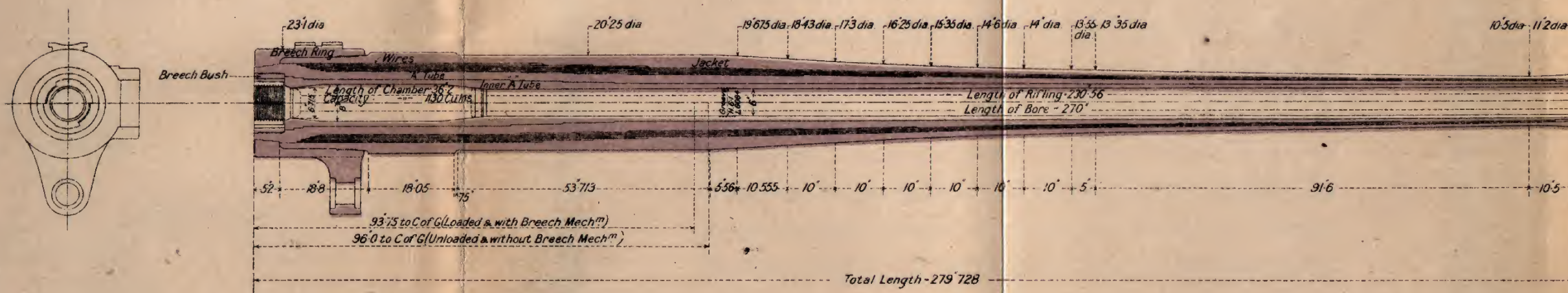
The interceptor run out contacts provide electrical communication between the terminals only when the gun is within 1 inch of the firing position, and are so arranged that the lower contacts drop when the gun recoils, and have to be deliberately replaced before the gun can be fired.

The length of cables is shown on Plate 43.



# ORDNANCE, B. L., 6-INCH, WIRE, MARK XII | N | STEEL, 7 TONS.

SCALE  $\frac{1}{36}$ .



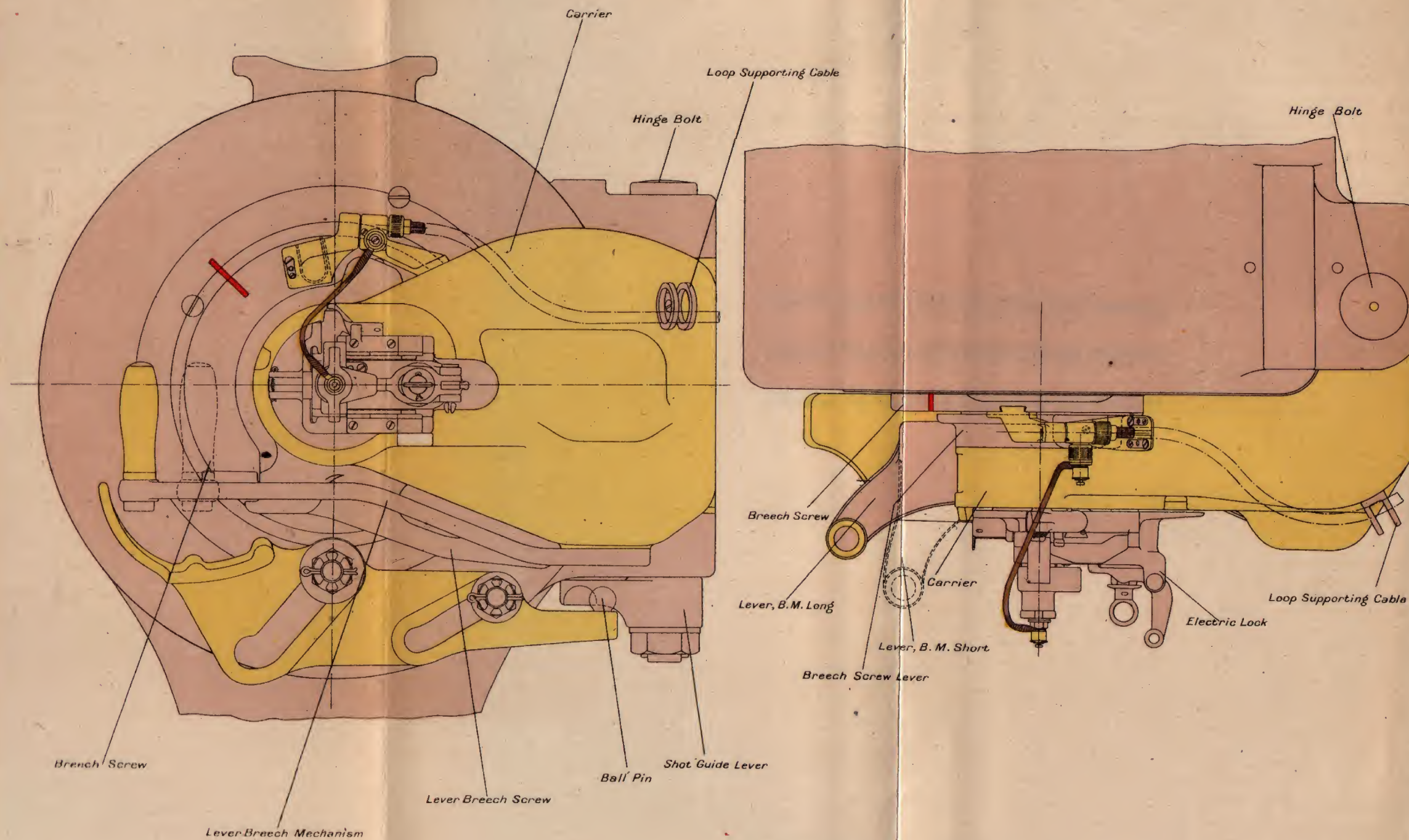
WEIGHT OF GUN (UNLOADED BUT WITH BREECH MECHANISM) 6 TONS, 17 CWT, 3 QRS.



# ORDNANCE, B.L. 6-INCH, WIRE MARK XII/N/.

## BREECH MECHANISM.

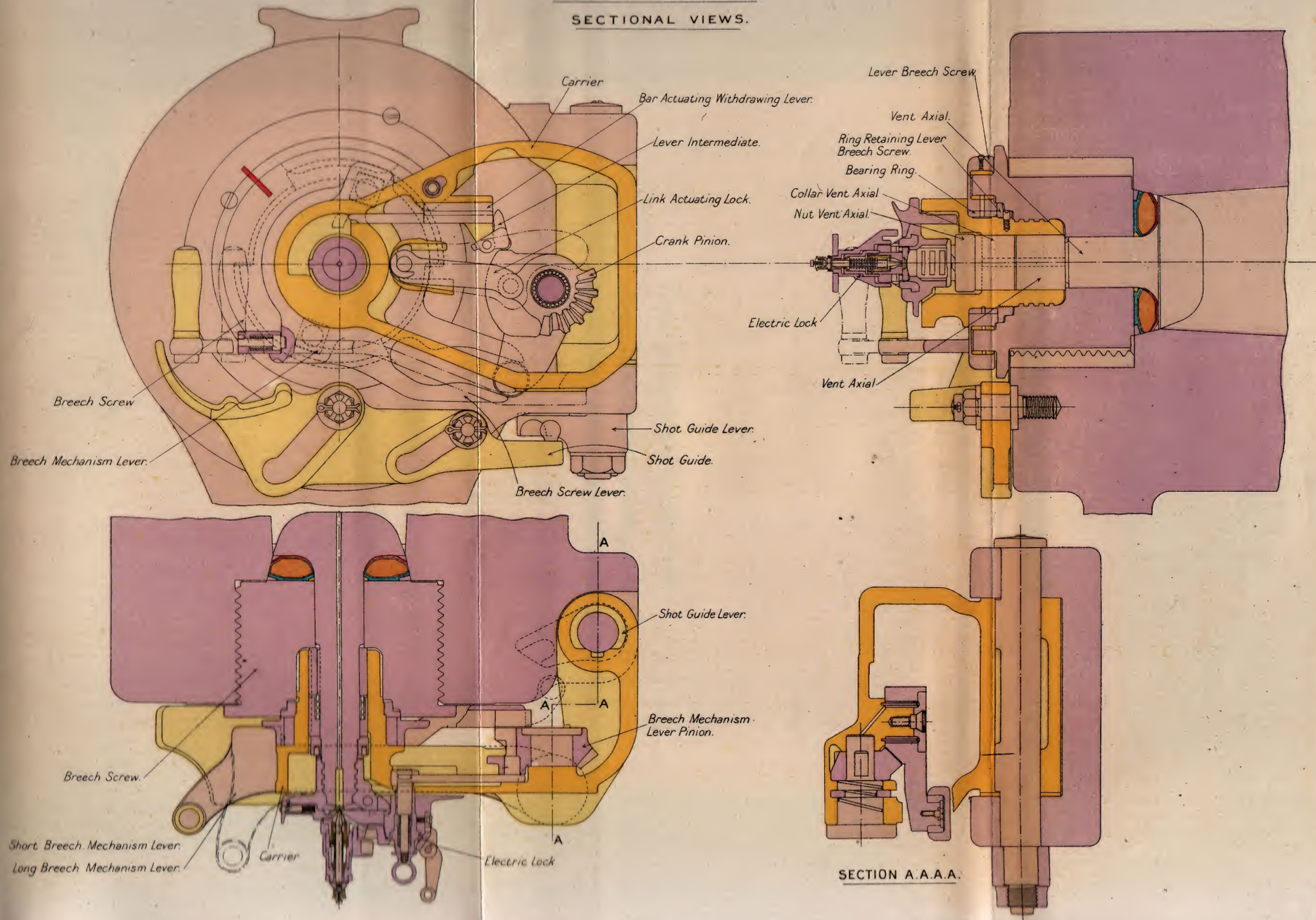
### OUTSIDE VIEWS.





BREECH MECHANISM.

SECTIONAL VIEWS.





# ORDNANCE, B.L.

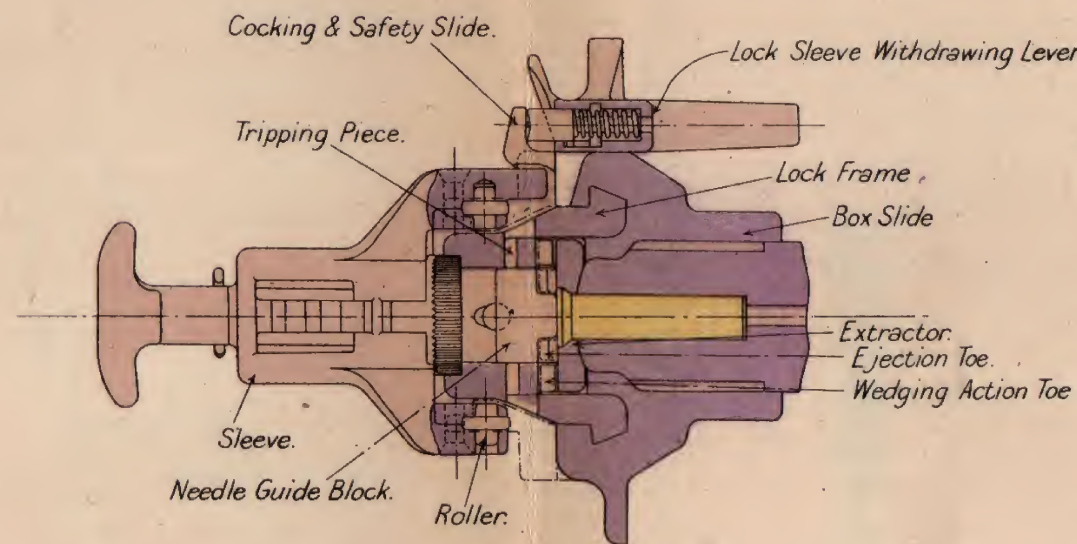
BOX SLIDE K (MARK I)

LOCK, PERCUSSION, "P.B" (MARK I)

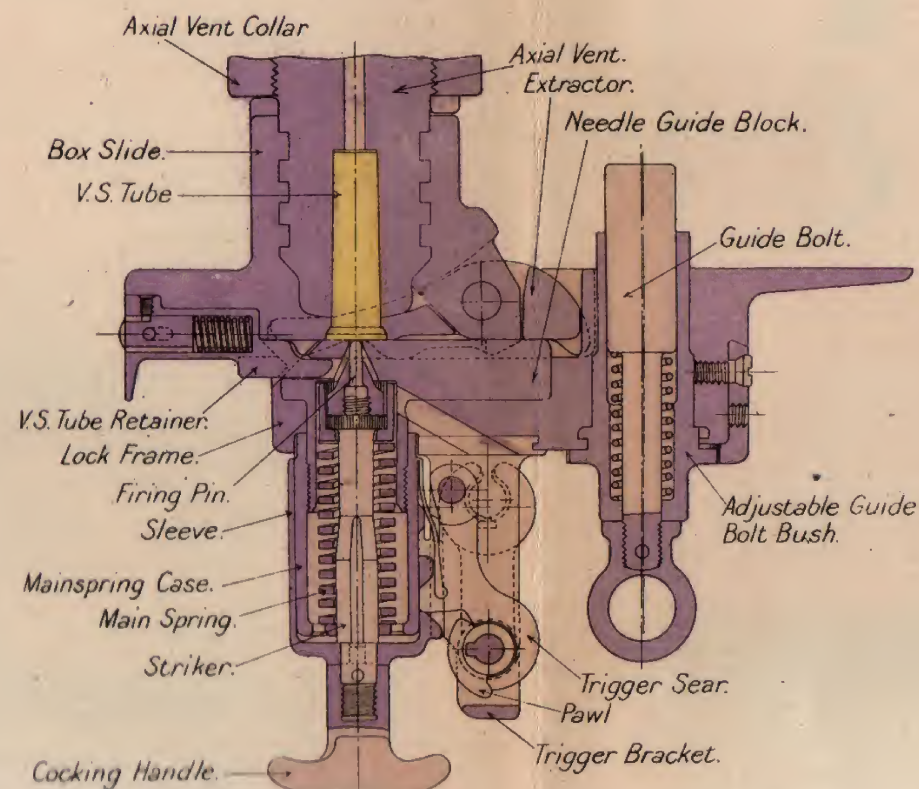
N 6 INCH MARK XII (EXCEPT FIRST 3 GUNS.)

N 6 INCH MARK XII (EXCEPT FIRST 3 GUNS.)

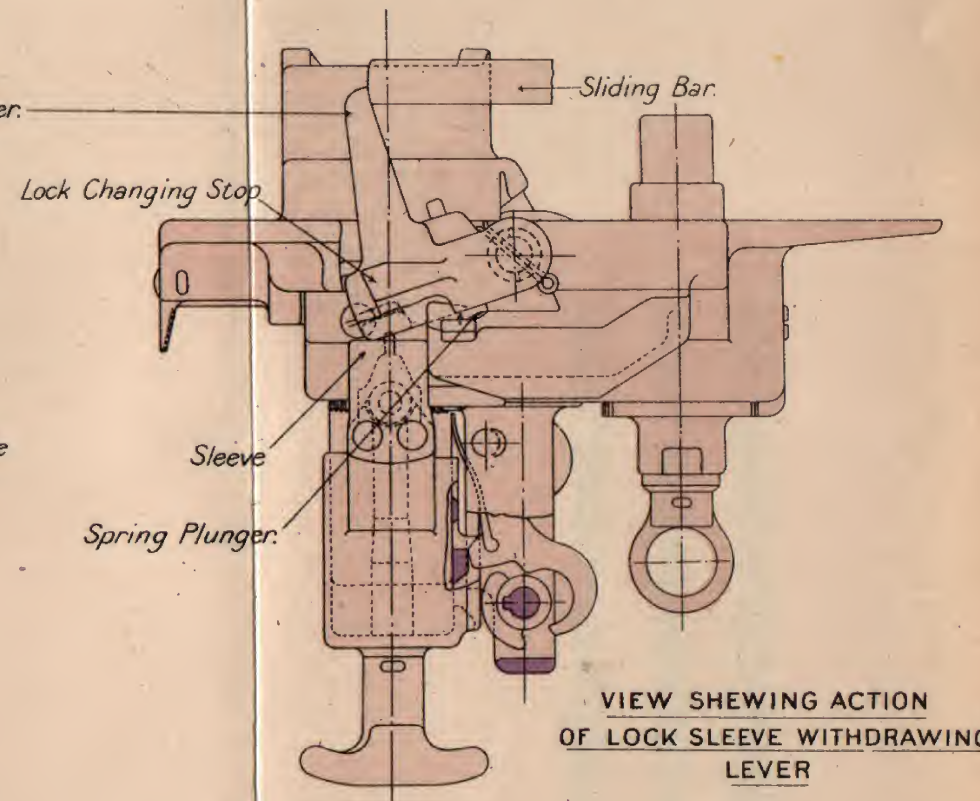
## GENERAL ARRANGEMENT.



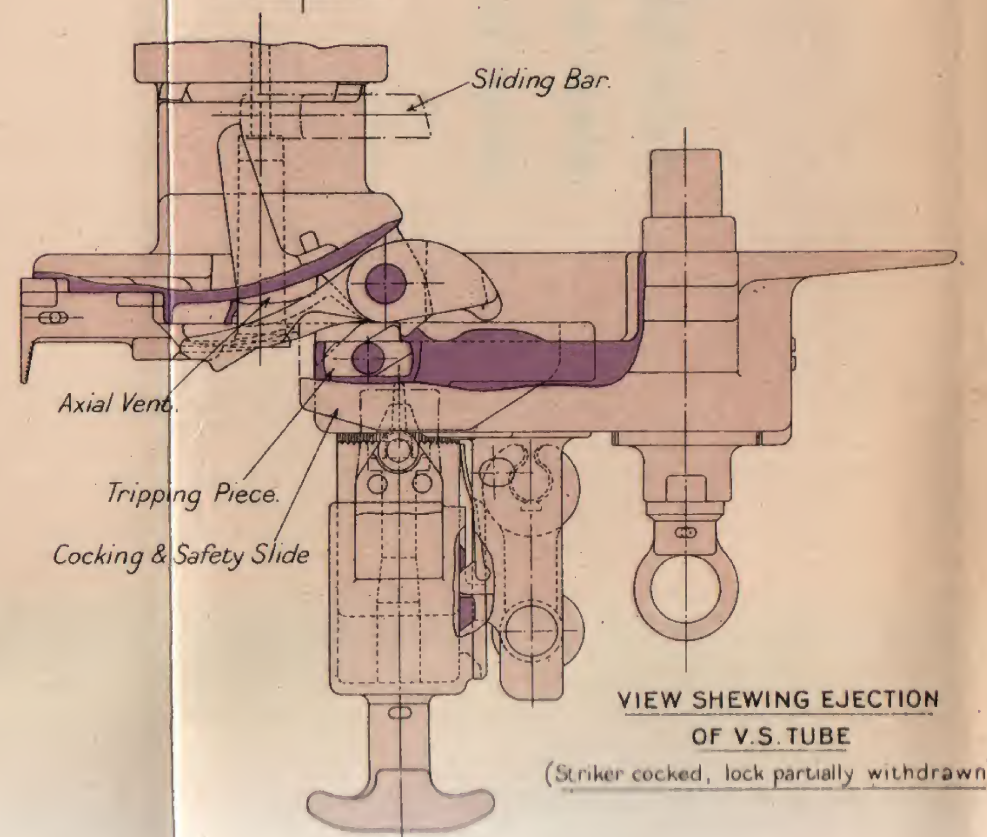
SECTION B.B.B.B.



SECTION A.A.



VIEW SHEWING ACTION  
OF LOCK SLEEVE WITHDRAWING  
LEVER



VIEW SHEWING EJECTION  
OF V.S. TUBE

(Striker cocked, lock partially withdrawn)

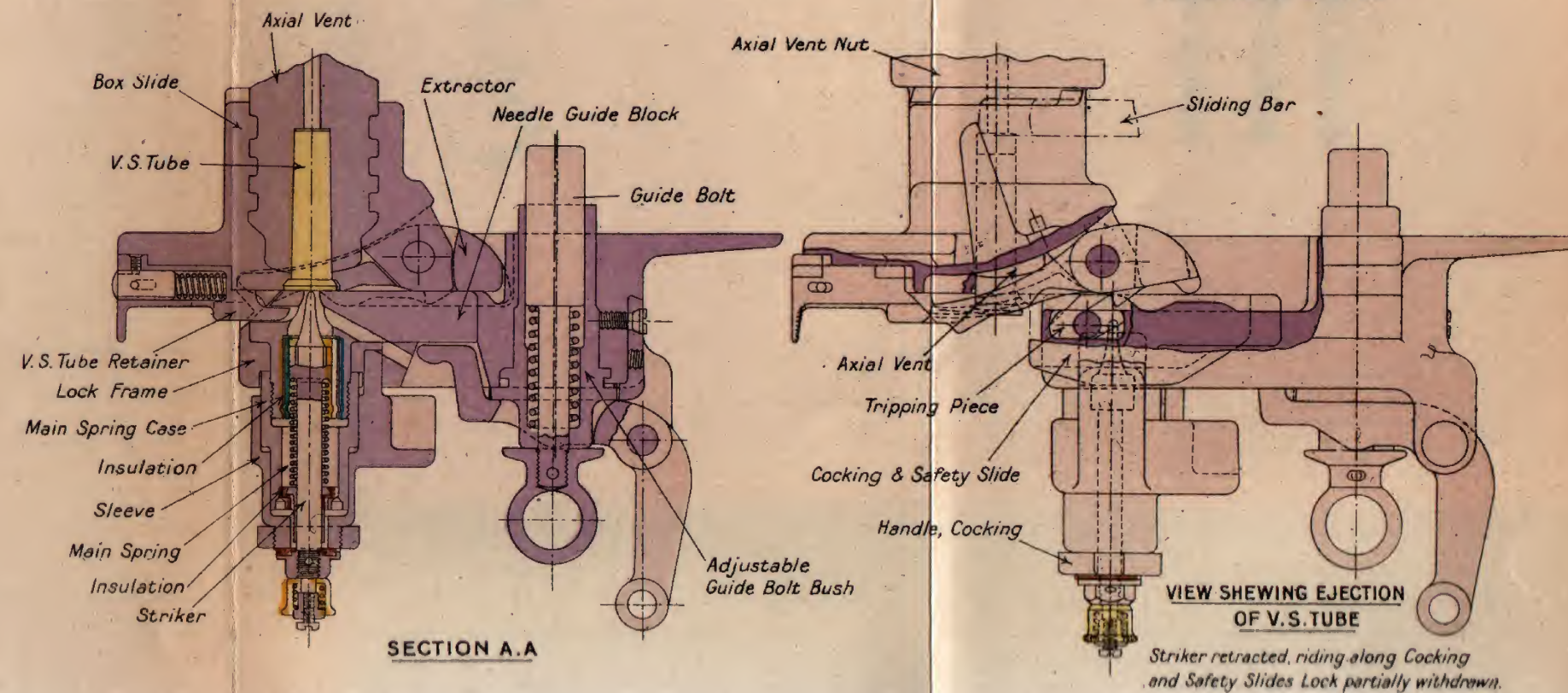
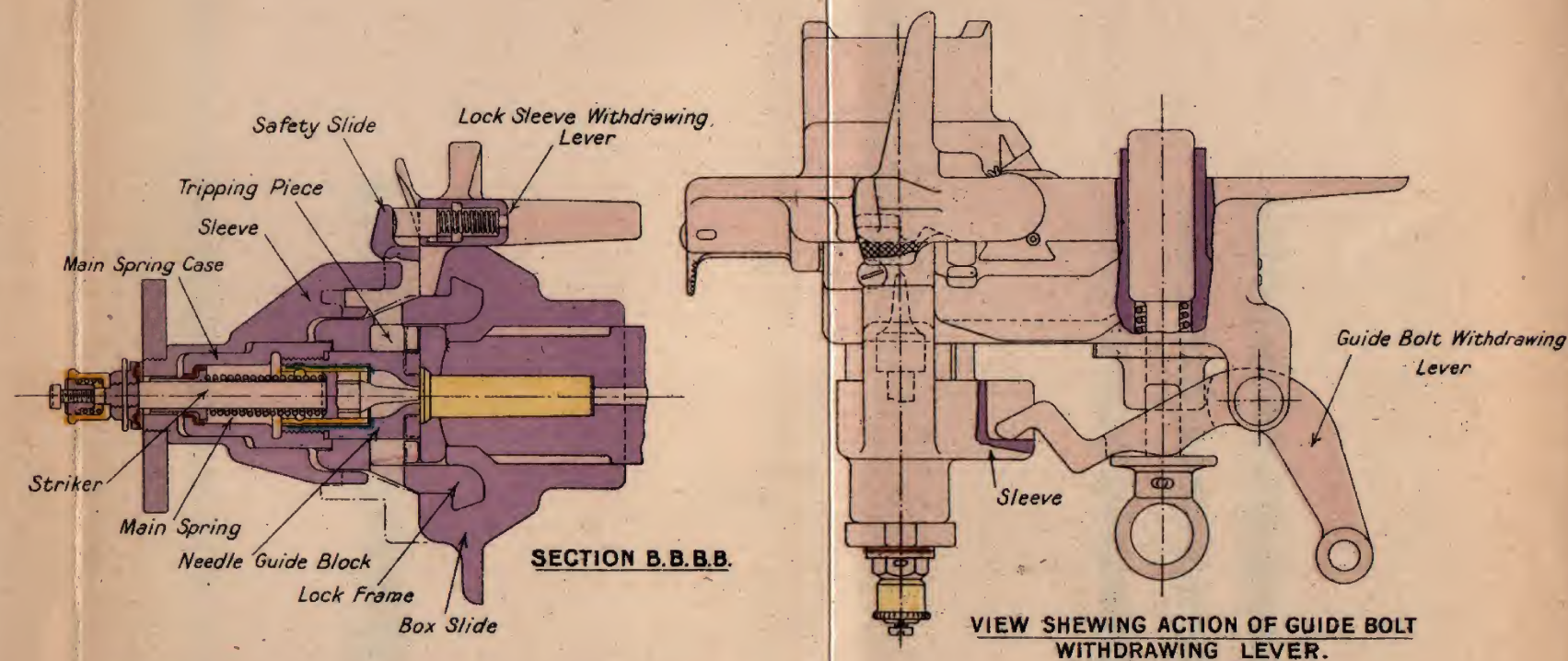


# ORDNANCE, B. L.:—

BOX, SLIDE, 'K' (MARK I) / N / 6 INCH MARK XII ( EXCEPT FIRST 3 GUNS)

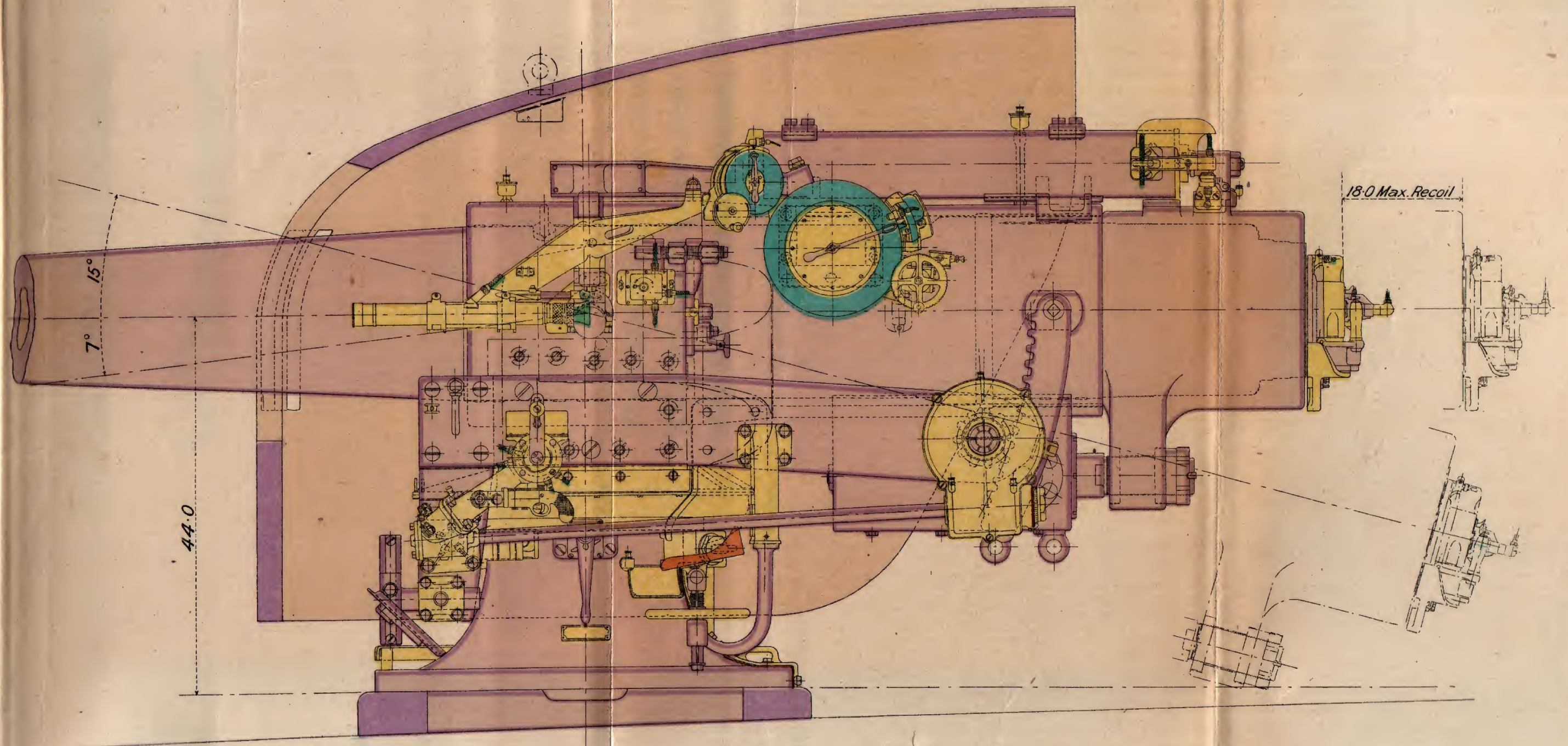
LOCK, ELECTRIC, 'E.B.' (MARK I) / N / 6-INCH MARK XII ( EXCEPT FIRST 3 GUNS)

## GENERAL ARRANGEMENT.





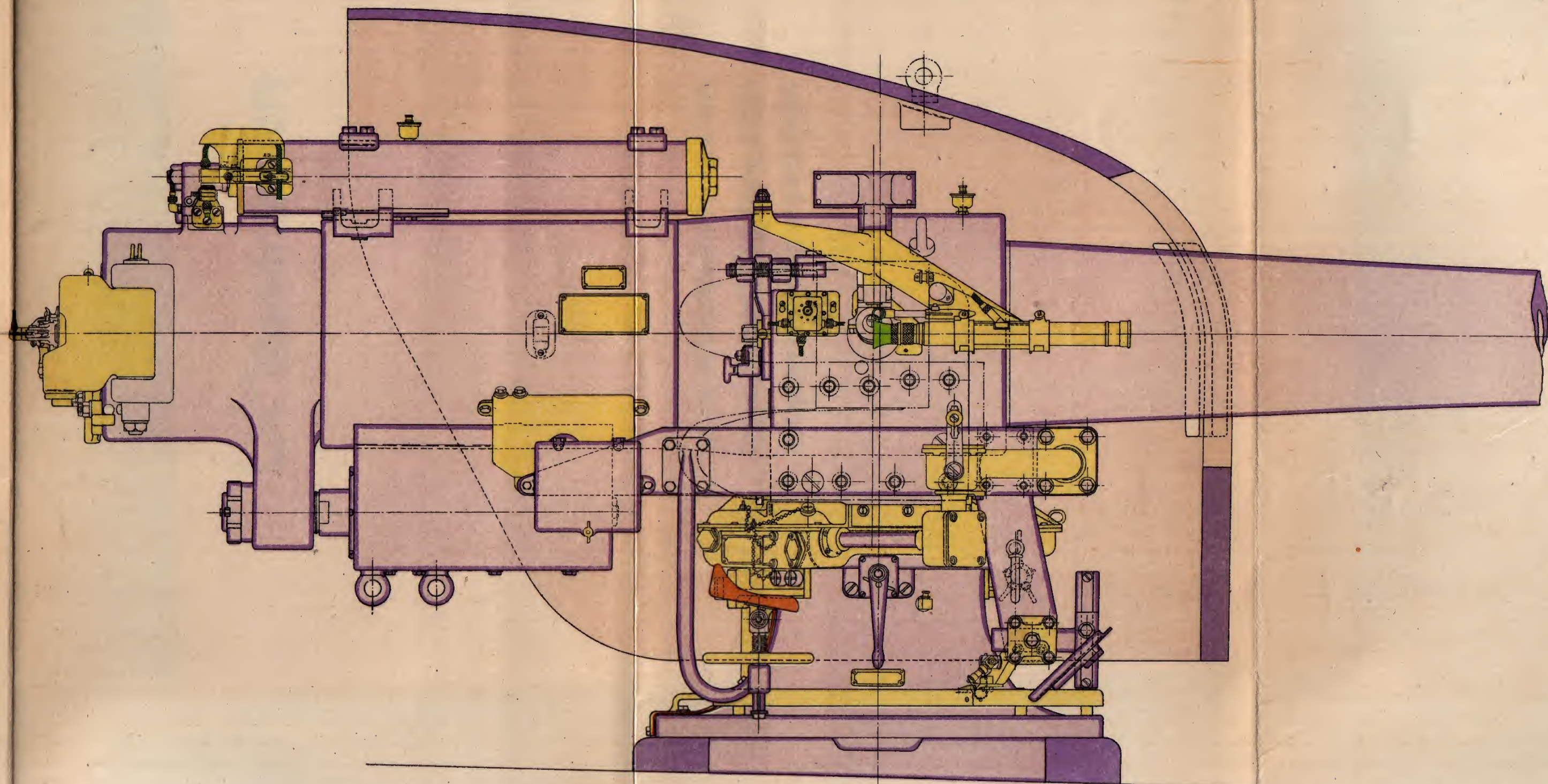
MOUNTING. 6 INCH. P. MARK VII.  
GENERAL ARRANGEMENT-LEFT HAND SIDE & REAR.





MOUNTING 6 INCH P. MARK VII.

GENERAL ARRANGEMENT - RIGHT HAND SIDE.

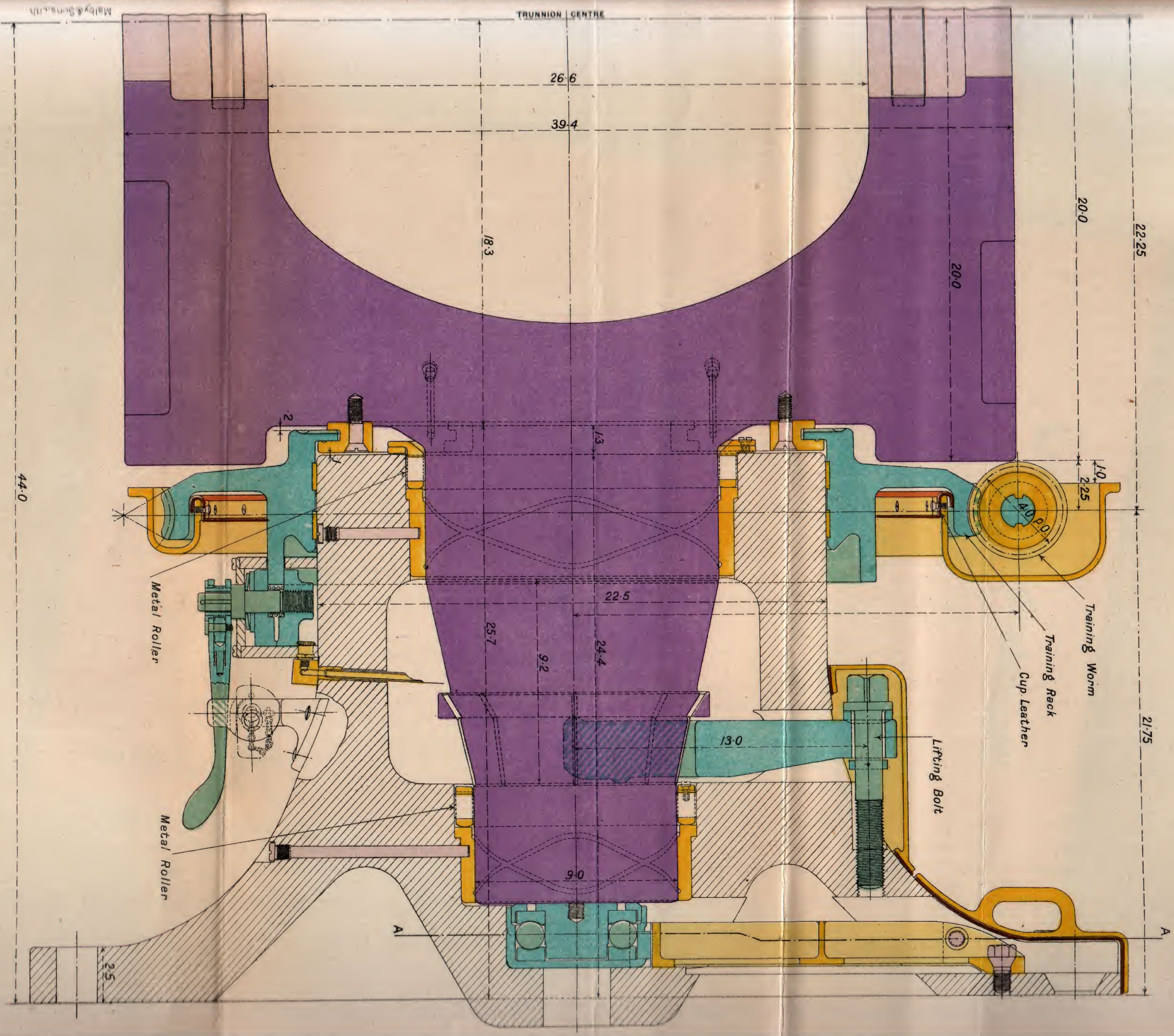




MOUNTING, 6 INCH. P. MARK VII & VII<sup>\*</sup>.

SECTION THROUGH PEDESTAL.

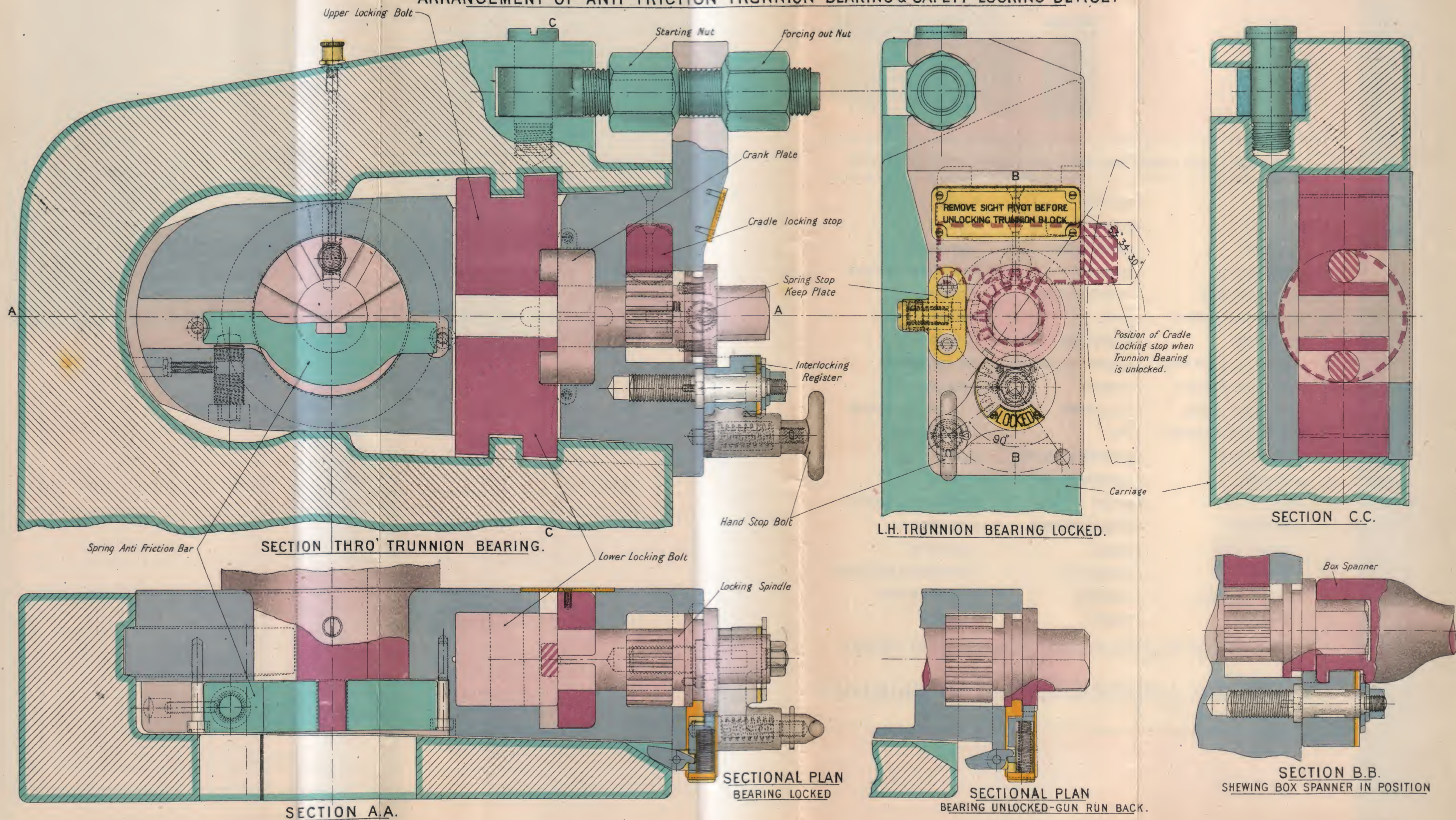
ALL DIMENSIONS ARE IN INCHES.





# MOUNTING 6 INCH. P MARK VII.

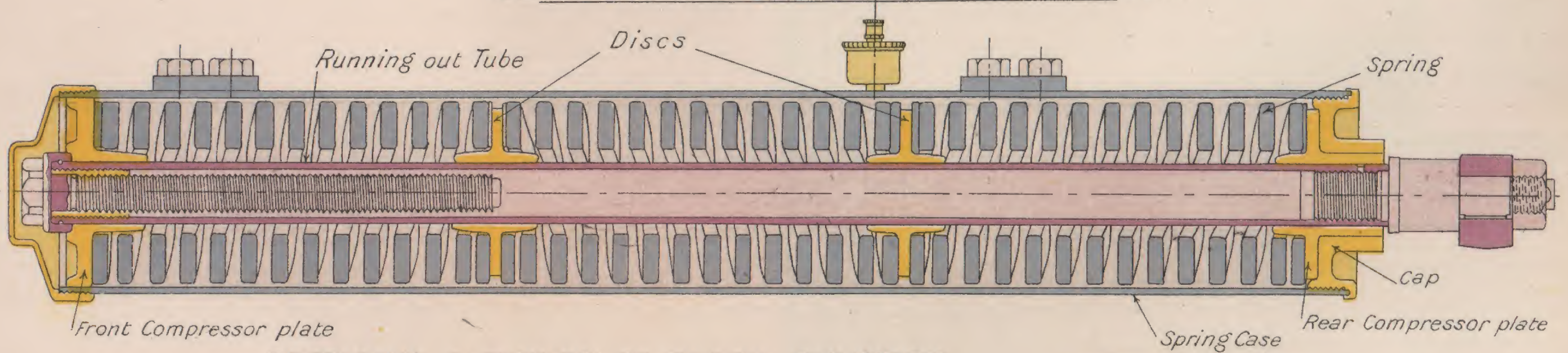
## ARRANGEMENT OF ANTI-FRICTION TRUNNION BEARING & SAFETY LOCKING DEVICE.



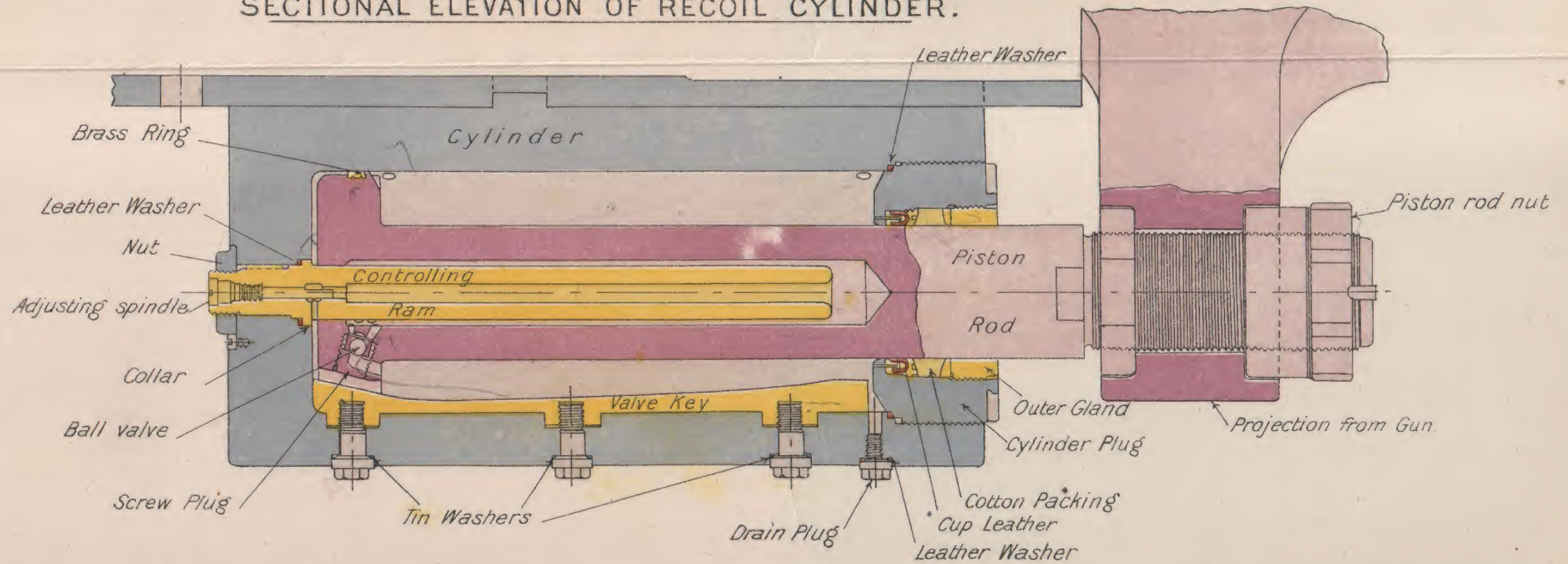


# MOUNTING 6<sup>IN</sup> P. MARK VII AND VII\* AND P. MARK XIII AND XIII\*

## SECTIONAL ELEVATION OF SPRING CASE.

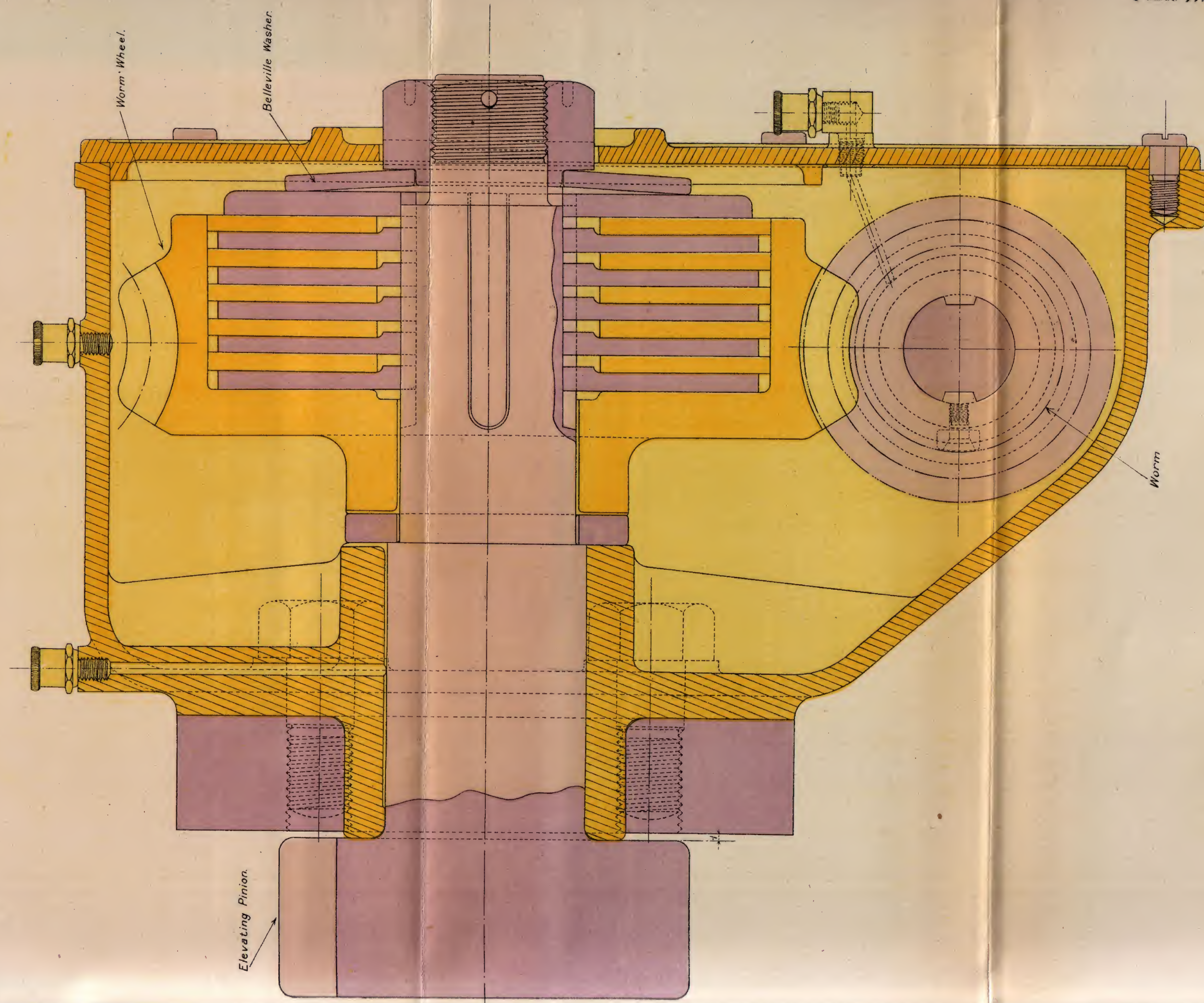


## SECTIONAL ELEVATION OF RECOIL CYLINDER.



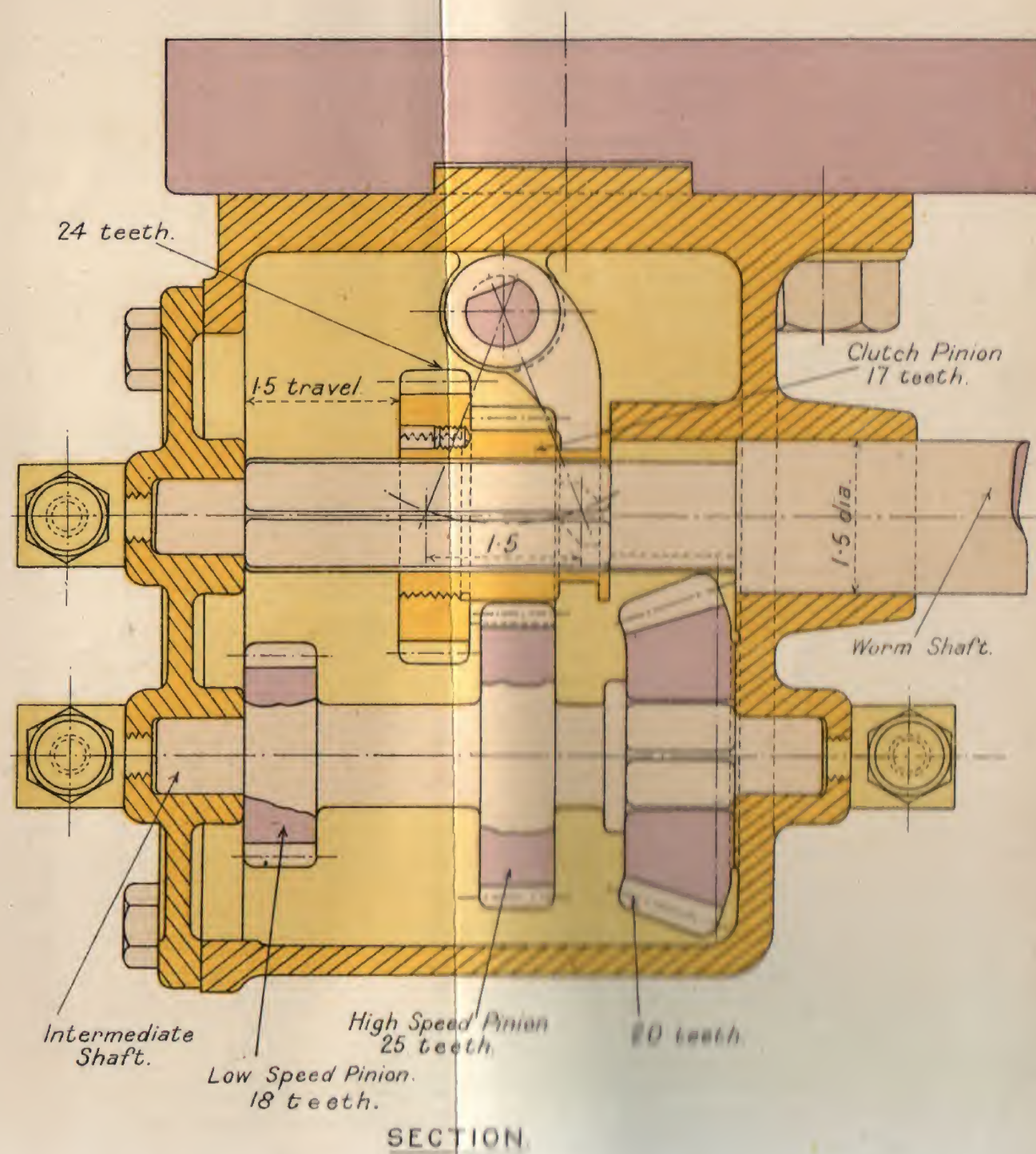


MOUNTING. 6 INCH. P. MARK VII.  
ARRANGEMENT OF ELEVATING GEAR.-SECTION THROUGH WORM & WORM WHEEL.  
ALL DIMENSIONS ARE IN INCHES.





MOUNTING. 6 INCH. P. MARK VII.  
ELEVATING GEAR. - ARRANGEMENT OF TWO SPEED BOX.

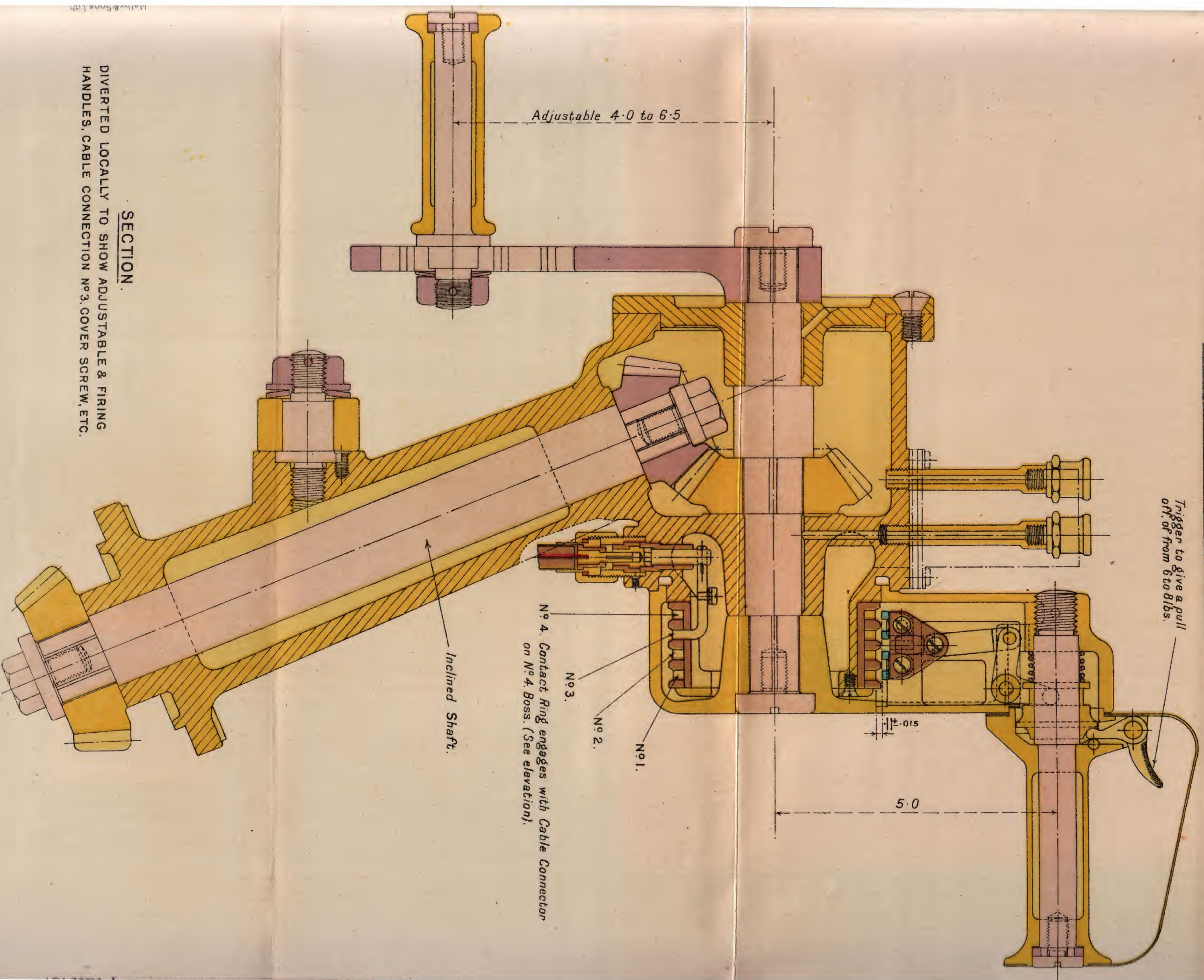




MOUNTING, 6 INCH, P. MARK VII.

ARRANGEMENT OF UPPER ELEVATING GEAR BOX WITH FIRING HANDLE & BUZZERS.

ALL DIMENSIONS ARE IN INCHES.

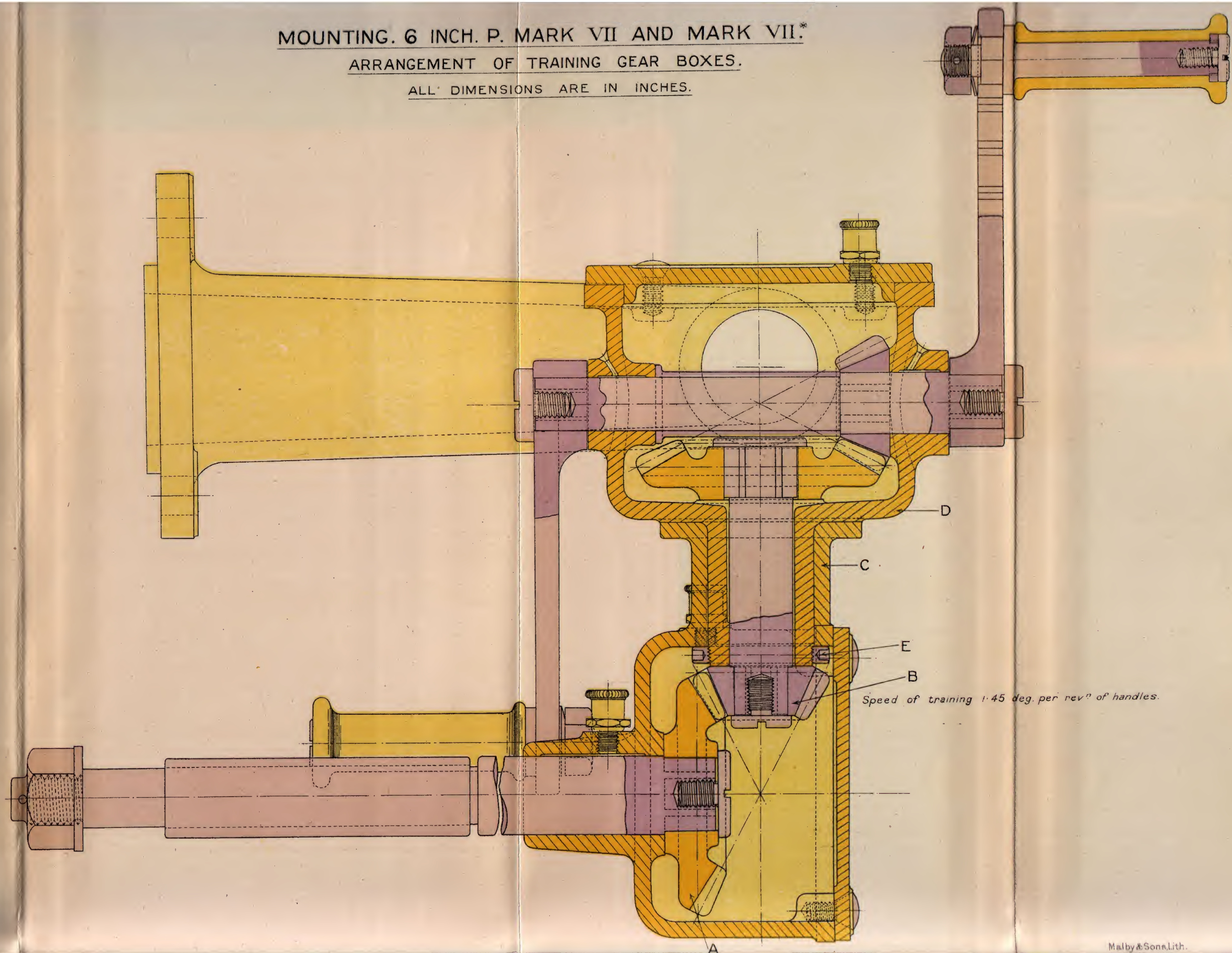




MOUNTING. 6 INCH. P. MARK VII AND MARK VII.\*

ARRANGEMENT OF TRAINING GEAR BOXES.

ALL DIMENSIONS ARE IN INCHES.



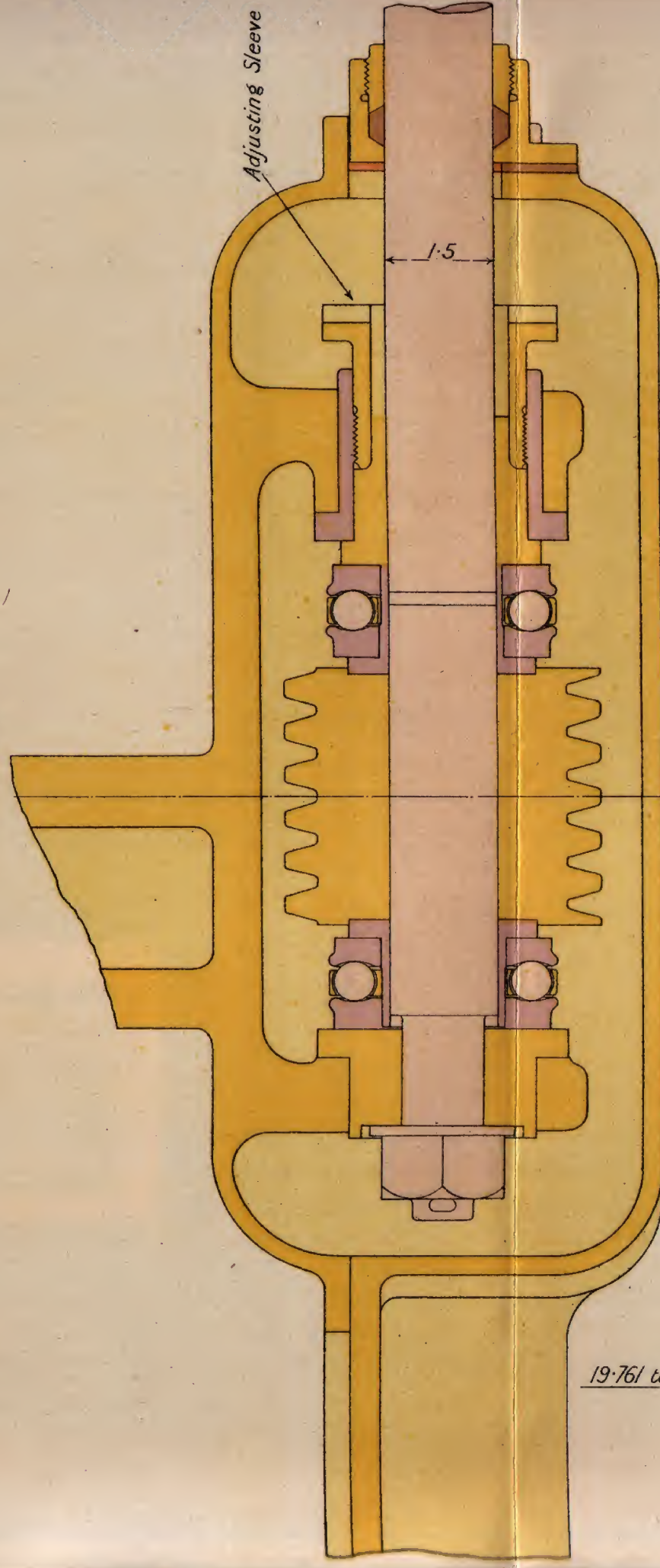


# MOUNTING 6 INCH. P. MARK VII\* AND P. MARK VII\*

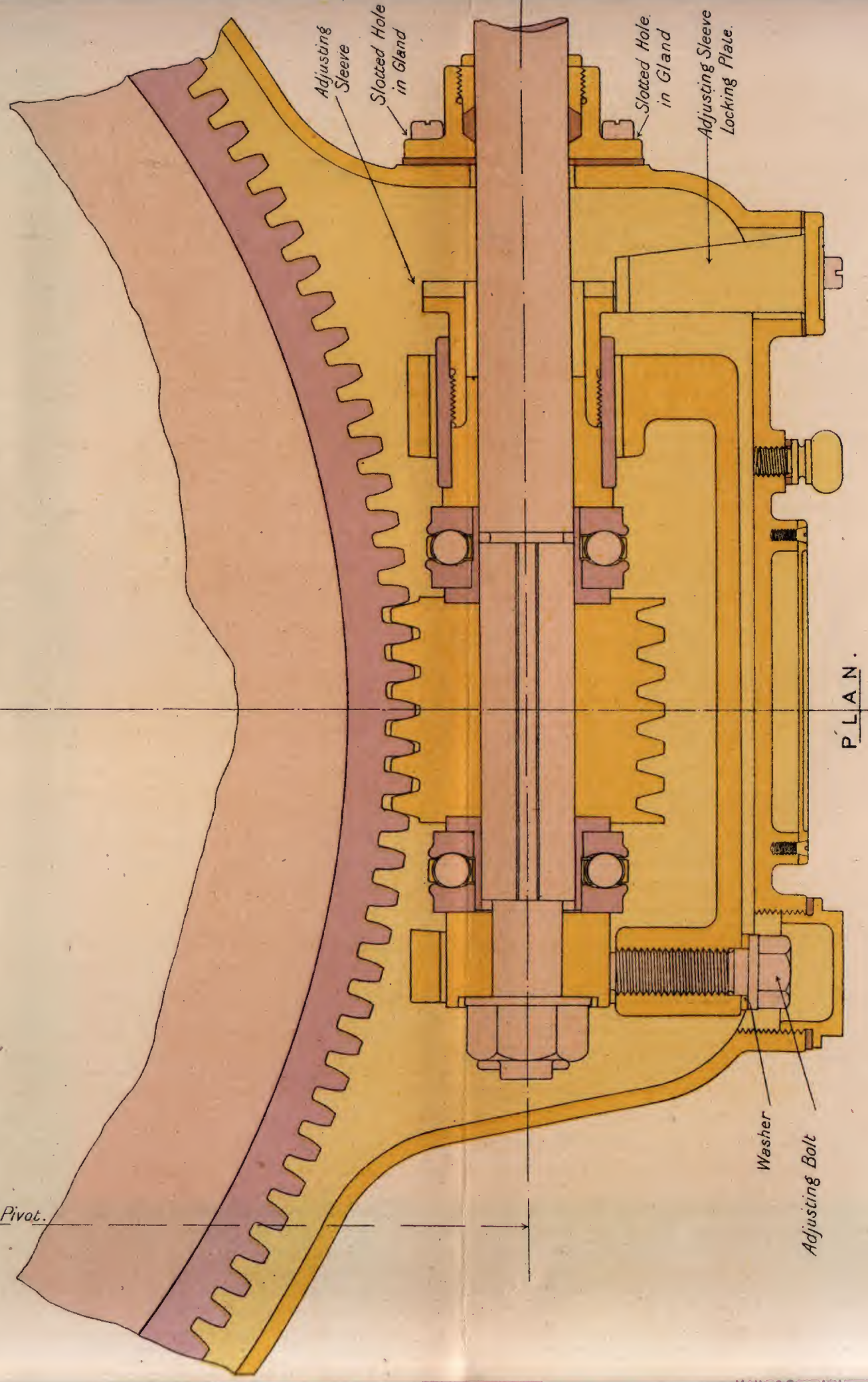
## ARRANGEMENT OF BEARINGS FOR TRAINING WORM.

ALL DIMENSIONS ARE IN INCHES.

ELEVATION.



19.761 to C.L. of Pivot.

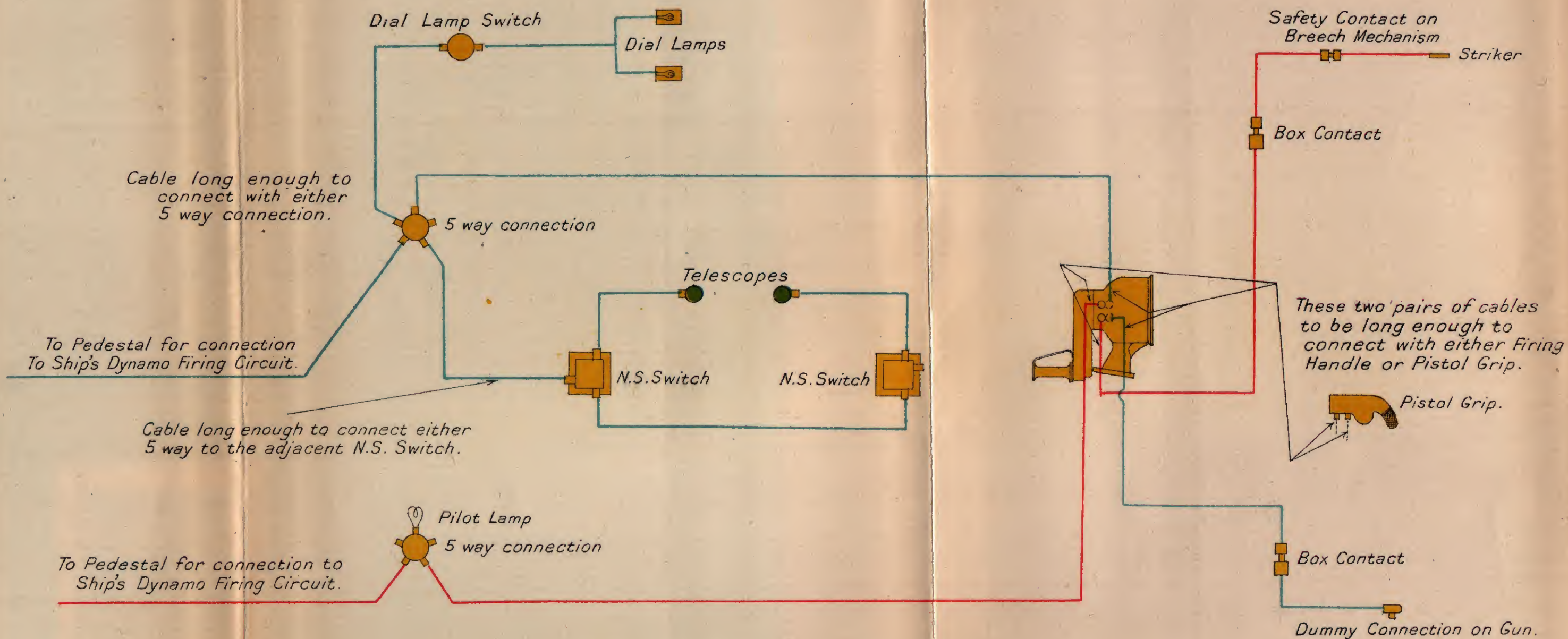


P.L.A.N.



# MOUNTING 6 INCH MARK P. VII. AND P. VII.\* MOUNTINGS 1-38.

## ARRANGEMENT OF ELECTRIC CIRCUITS.



Main Cables; — Coloured Red.

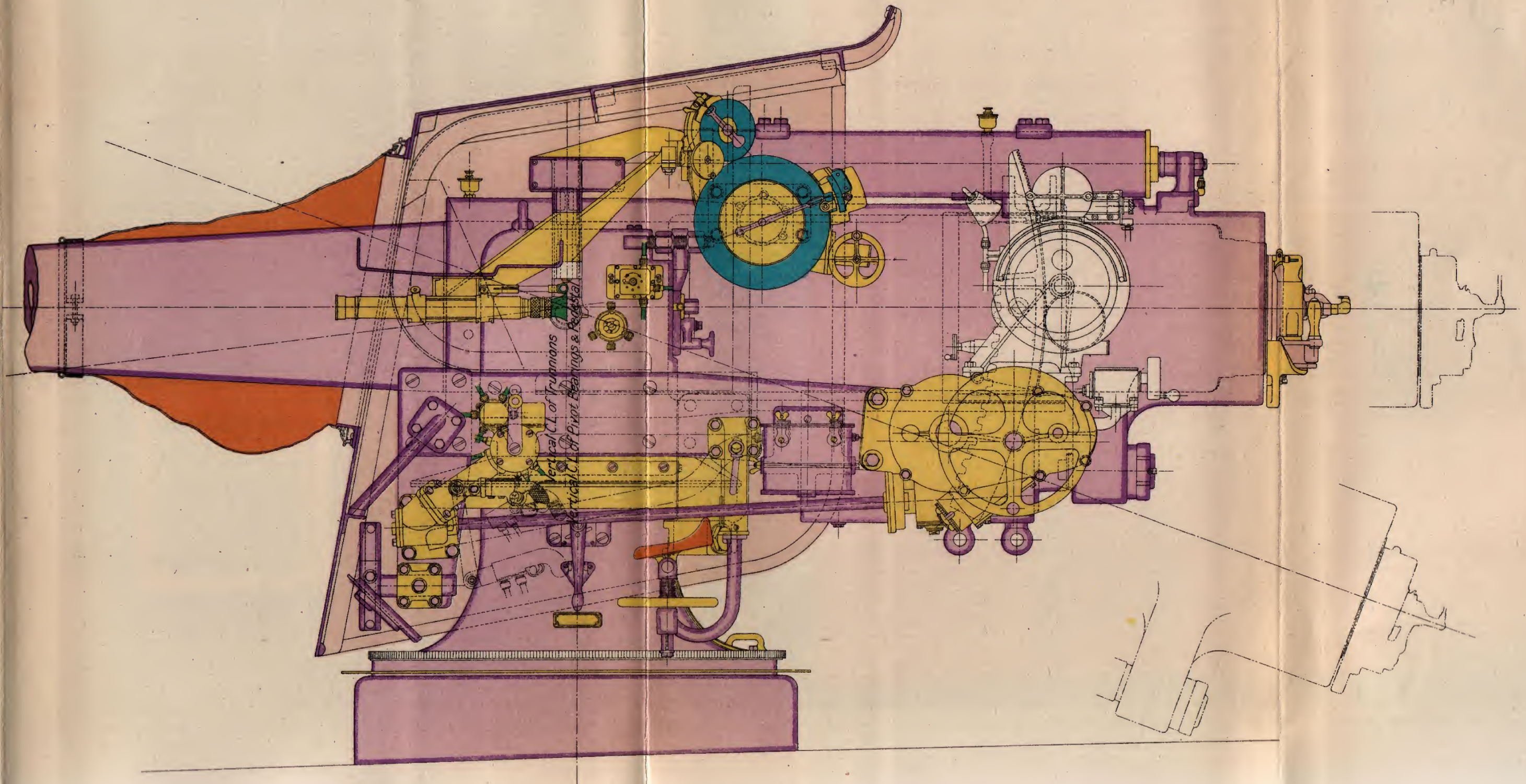
Auxiliary Cables; — Coloured Blue.



MOUNTING 6 INCH P MARK VII\*.

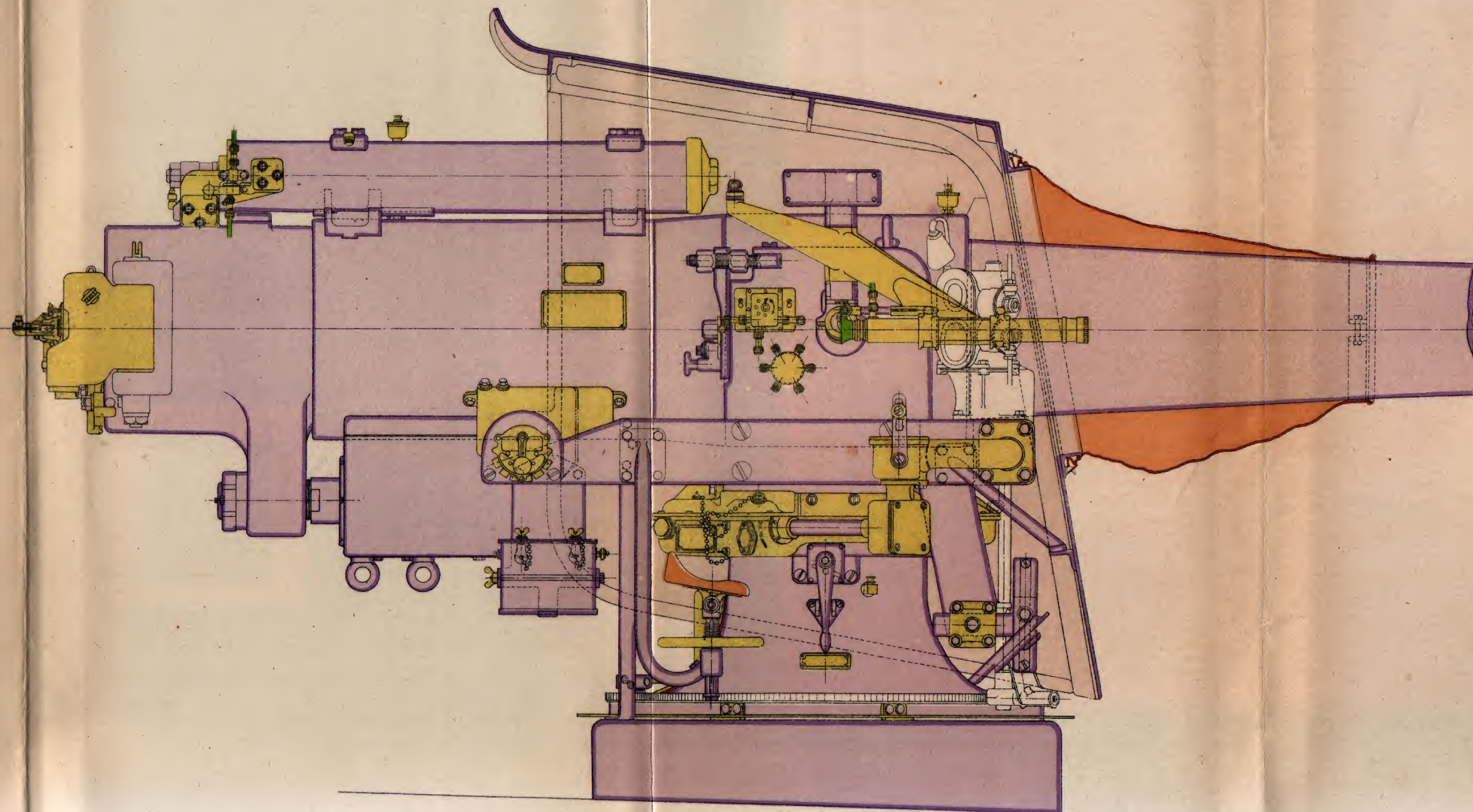
(ARRANGED FOR 20° ELEVATION.)

GENERAL ARRANGEMENTS - LEFT HAND SIDE.





MOUNTING 6 INCH P. MARK VII\*.  
ARRANGED FOR 20° ELEVATION.  
GENERAL ARRANGEMENT - RIGHT HAND SIDE.

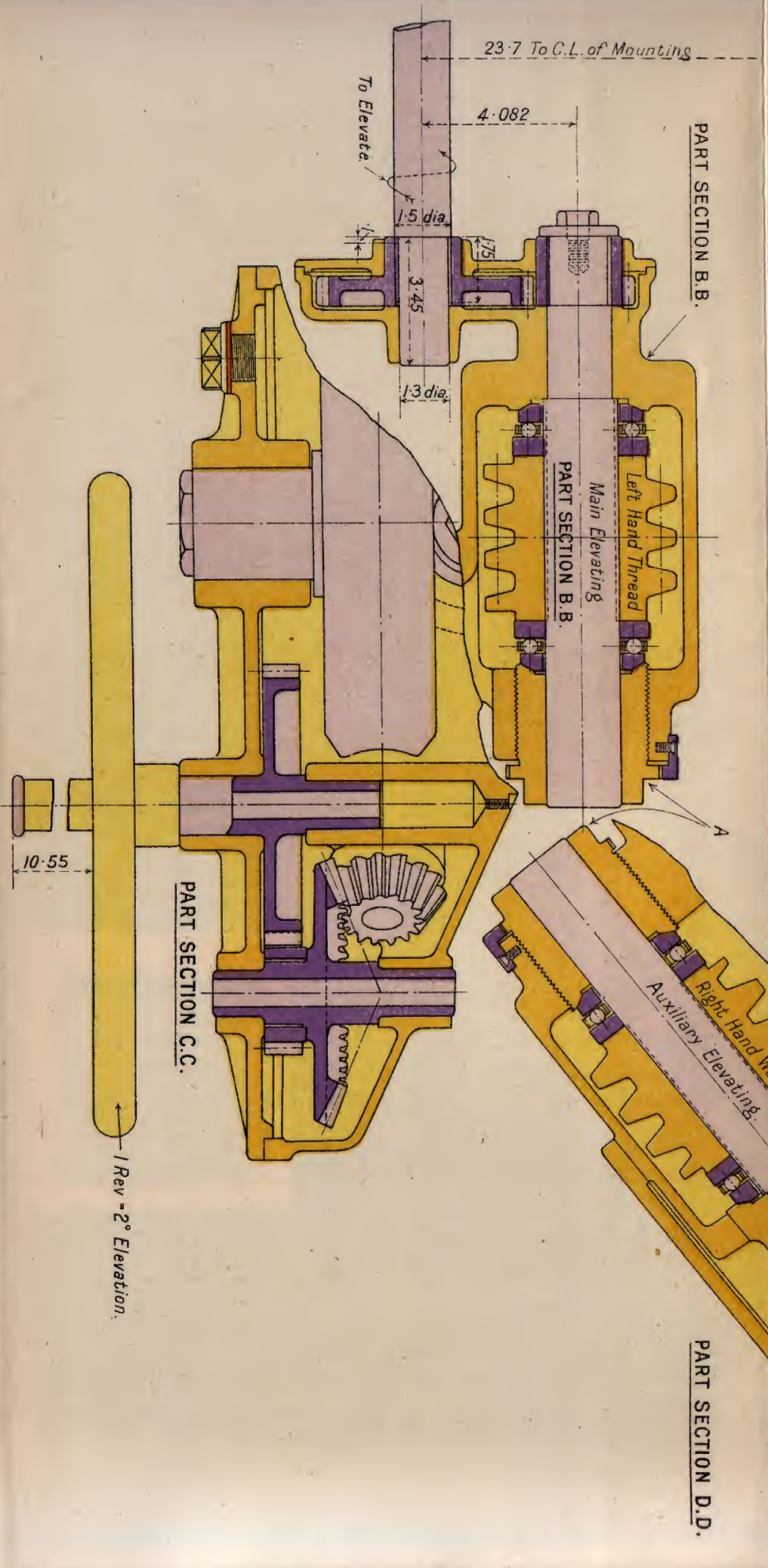
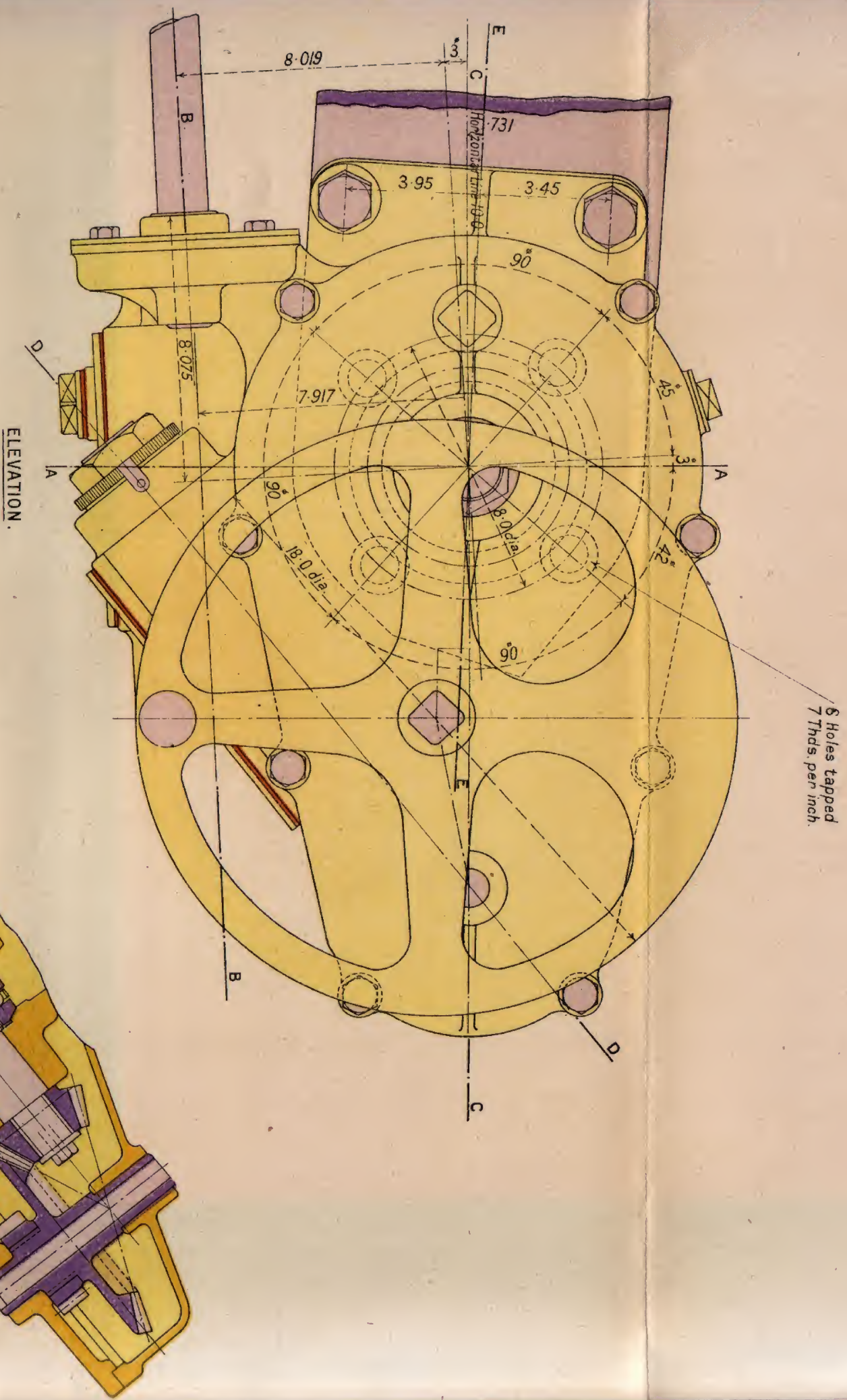




# MOUNTING, 6 INCH, P. MARK VII\*.

## ARRANGEMENT OF DIFFERENTIAL ELEVATING GEAR.

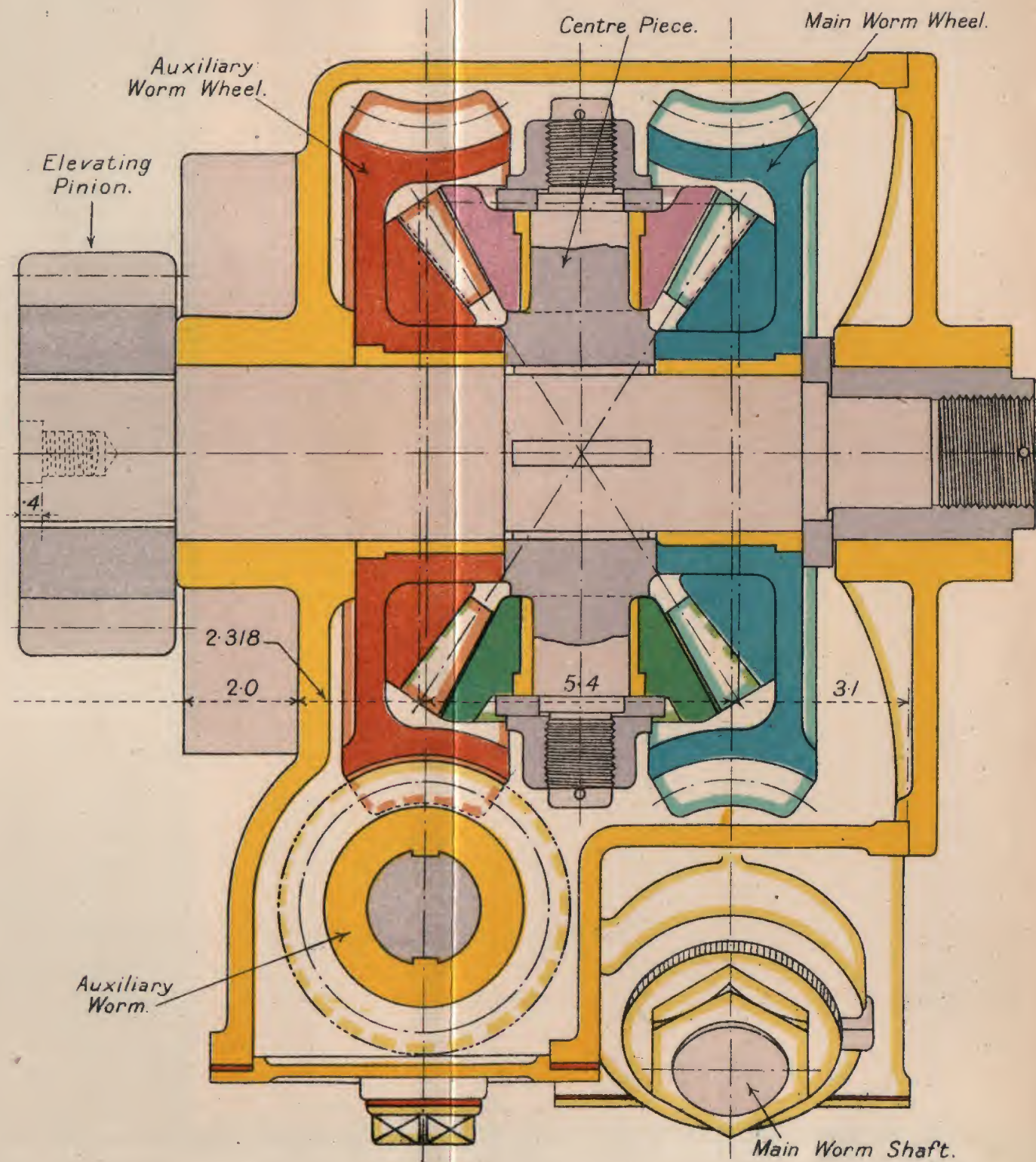
ALL DIMENSIONS ARE IN INCHES.





# DIFFERENTIAL ELEVATING GEAR.

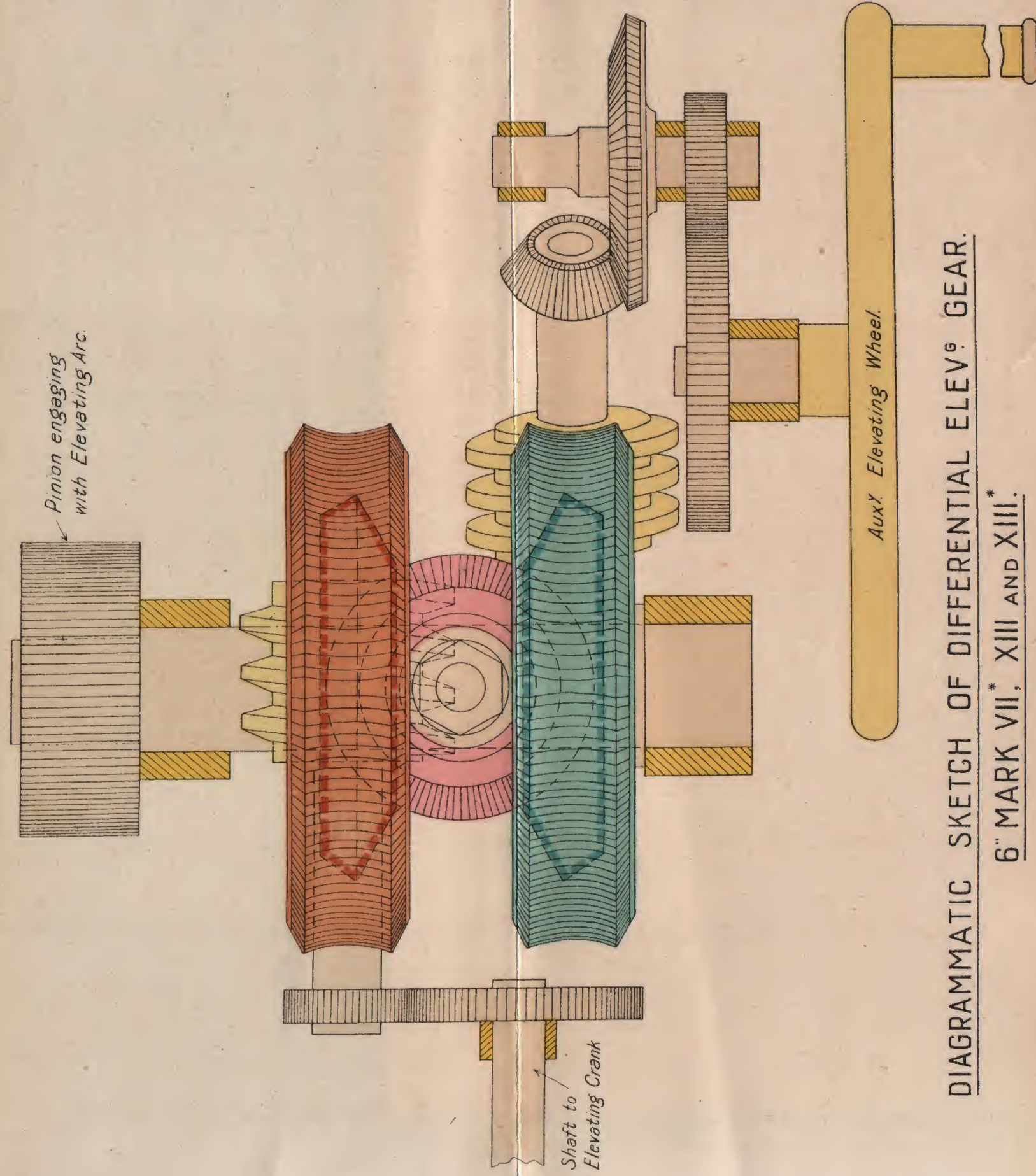
6" P MARK VII\*, XIII AND XIII\*.



PART SECTION A.A.

See Plate 19.



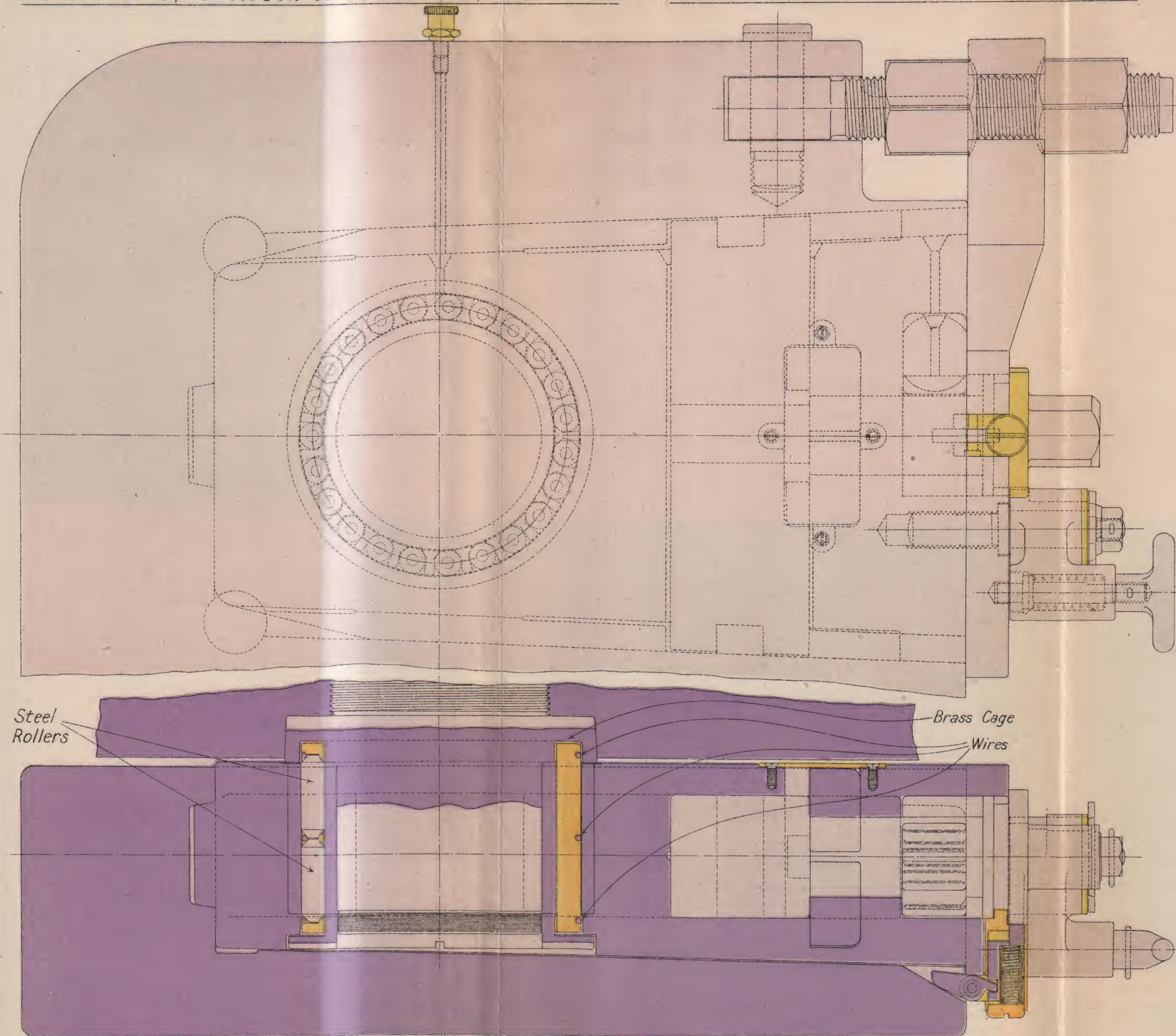


DIAGRAMMATIC SKETCH OF DIFFERENTIAL ELEV<sup>g</sup> GEAR.

6" MARK VII\*, XIII AND XIII\*.



Plate 22.
 MOUNTING, 6 INCH. P. MARK VII\*, XIII & XIII\*.-ARRANGEMENT OF TRUNNION LOCKING GEAR.



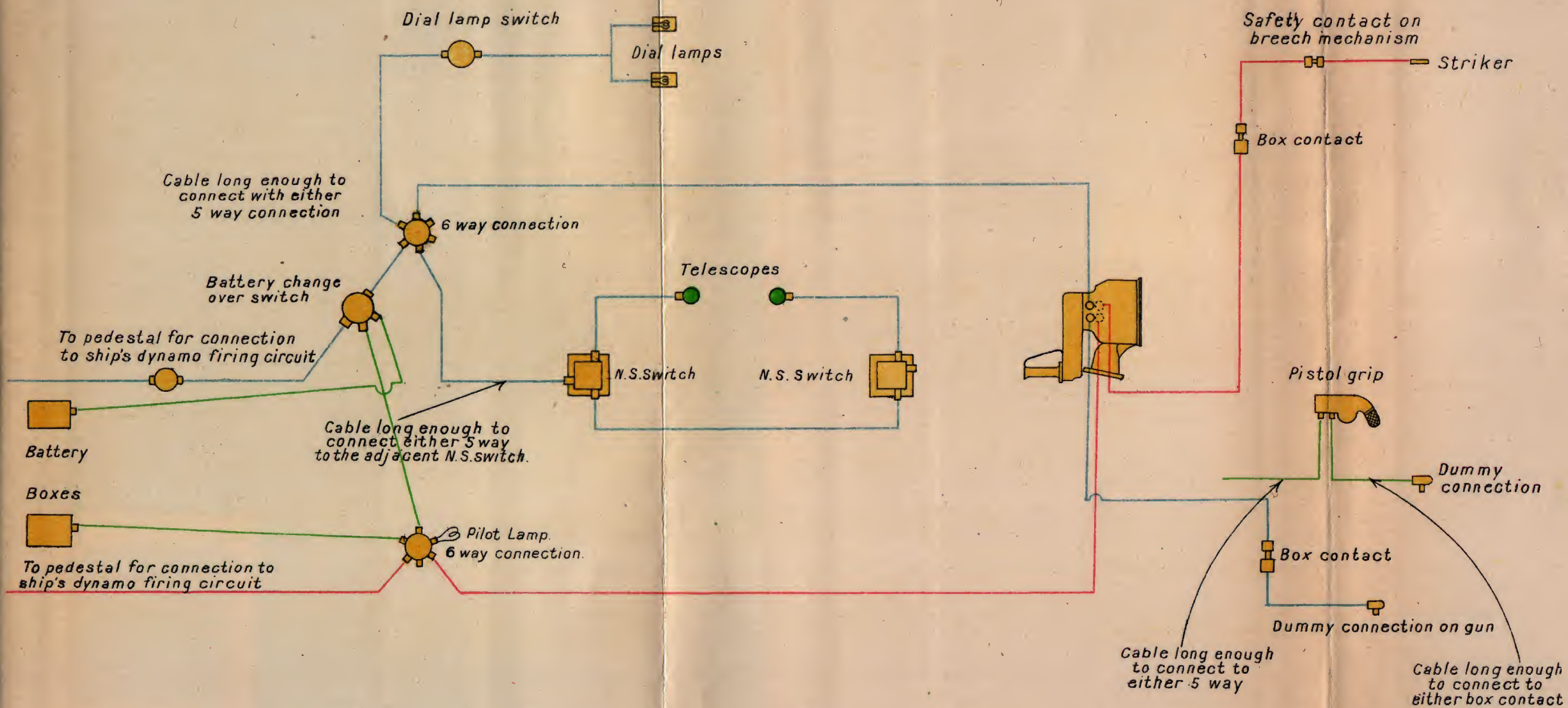
SECTION

Malby & Sons, Lith.



# MOUNTING 6 INCH P. MARK VII\* MOUNTINGS 39-47.

## ARRANGEMENT OF ELECTRIC CIRCUITS.



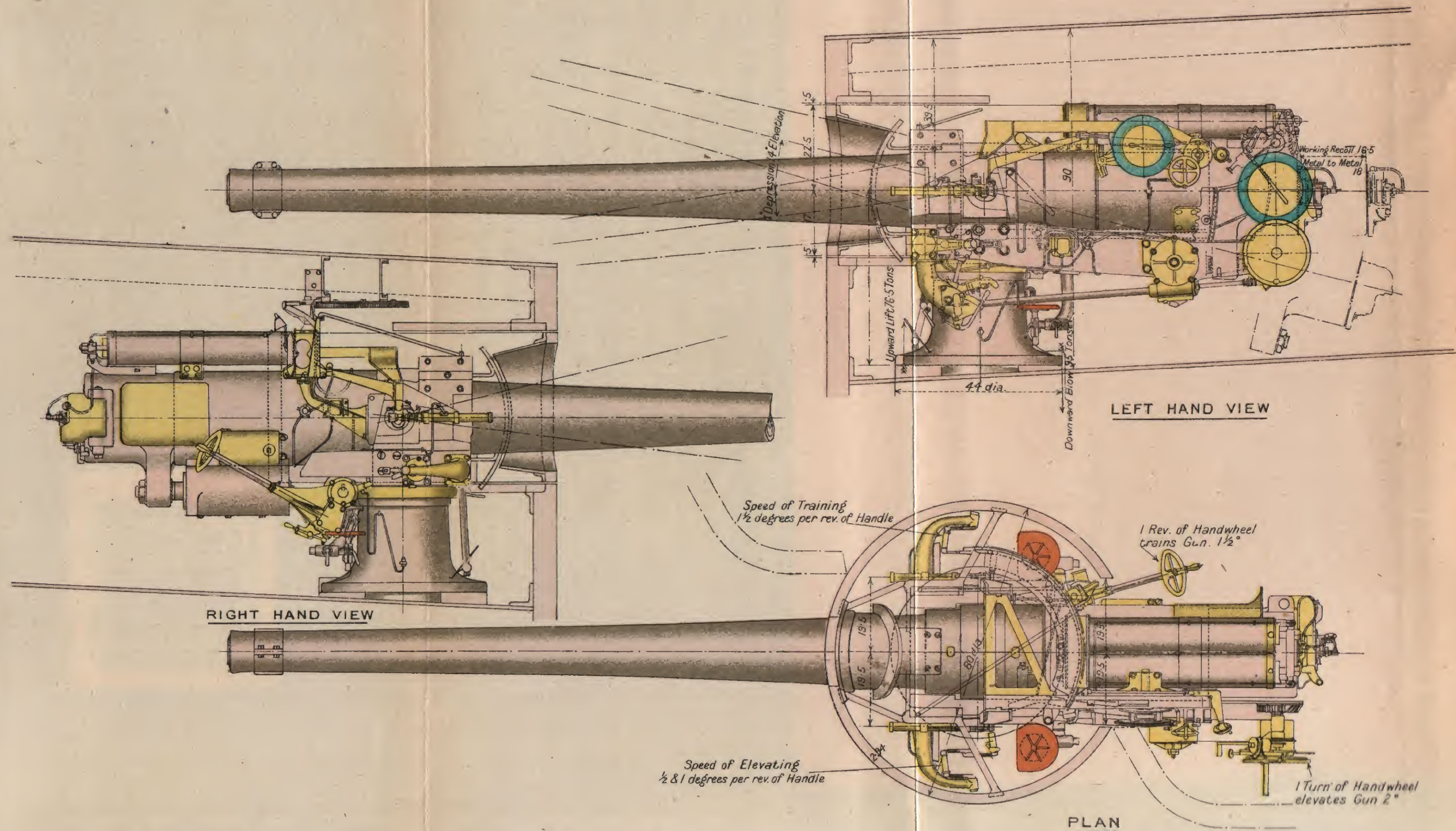
Main Cables; coloured Red.      Auxiliary cables; coloured Blue.  
Battery and Pistol grip Cables; coloured Green.



# ORDNANCE B.L. 6 INCH 45 CALIBRES.

## PEDESTAL MOUNTING P. MARK IX.

### GENERAL ARRANGEMENT SHOWING ELEVATING & TRAINING DIRECTOR GEARS.

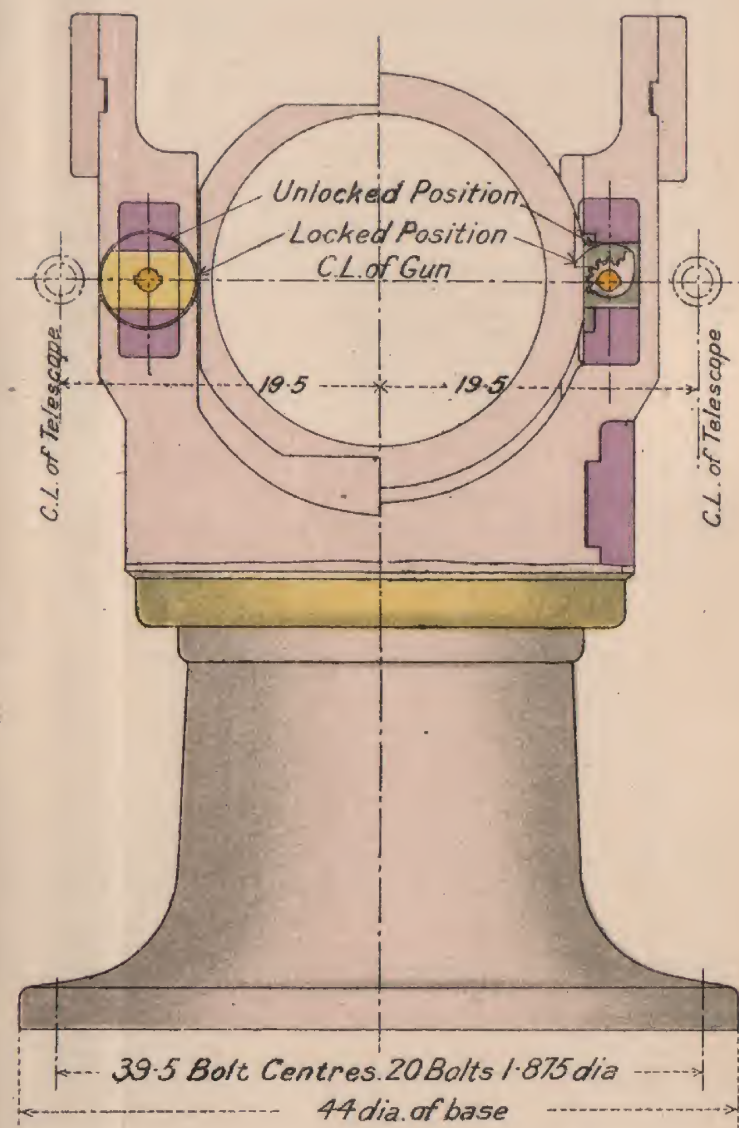




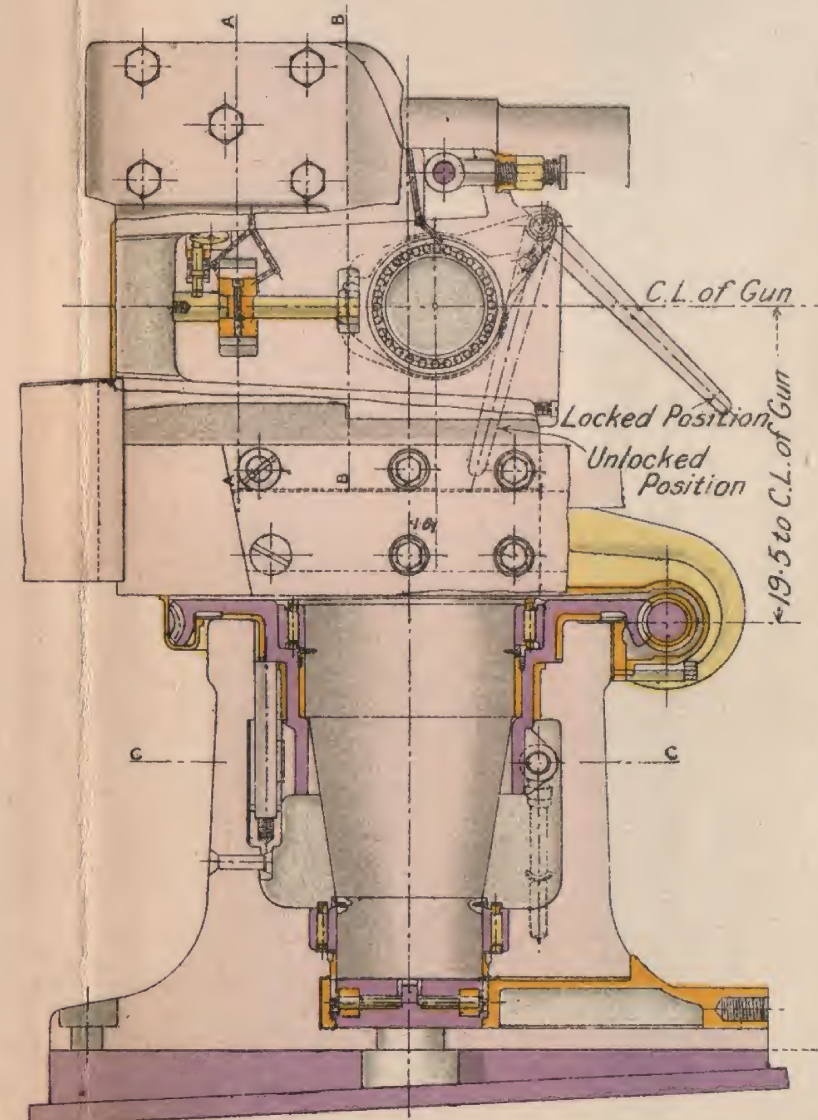
# ORDNANCE B.L. 6 INCH 45 CALIBRES.

## PEDESTAL MOUNTING. P. MARK IX.

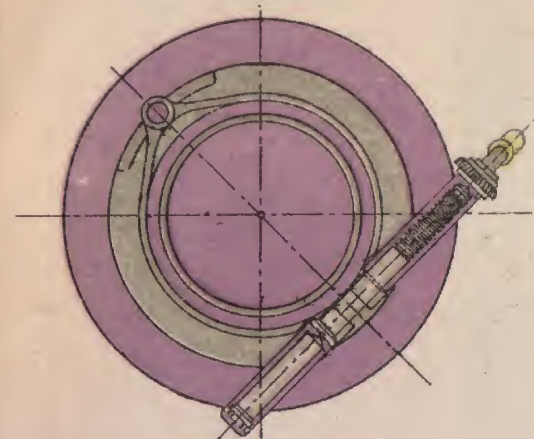
### ARRANGEMENT OF CARRIAGE AND PEDESTAL.



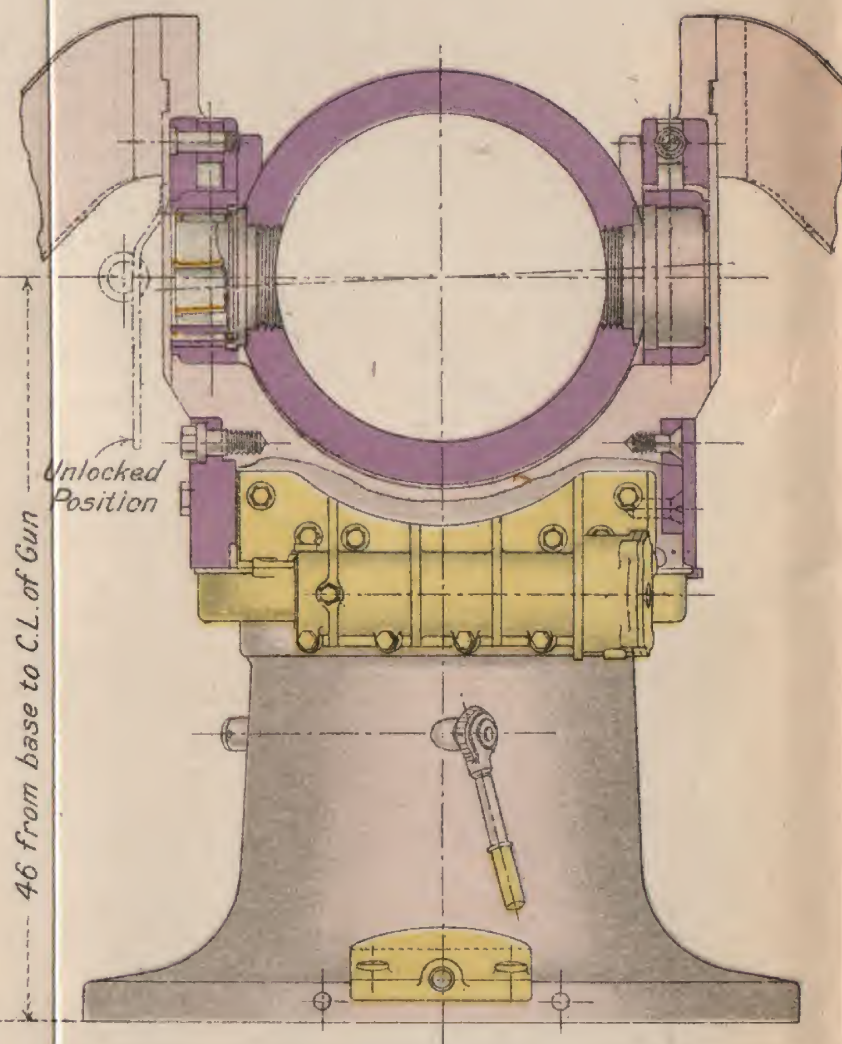
PART SECTION ON A.A. - PART SECTION ON B.B.



SECTION THROUGH PEDESTAL & ON C.L. OF TRUNNION BLOCK.



SECTION ON C.C.



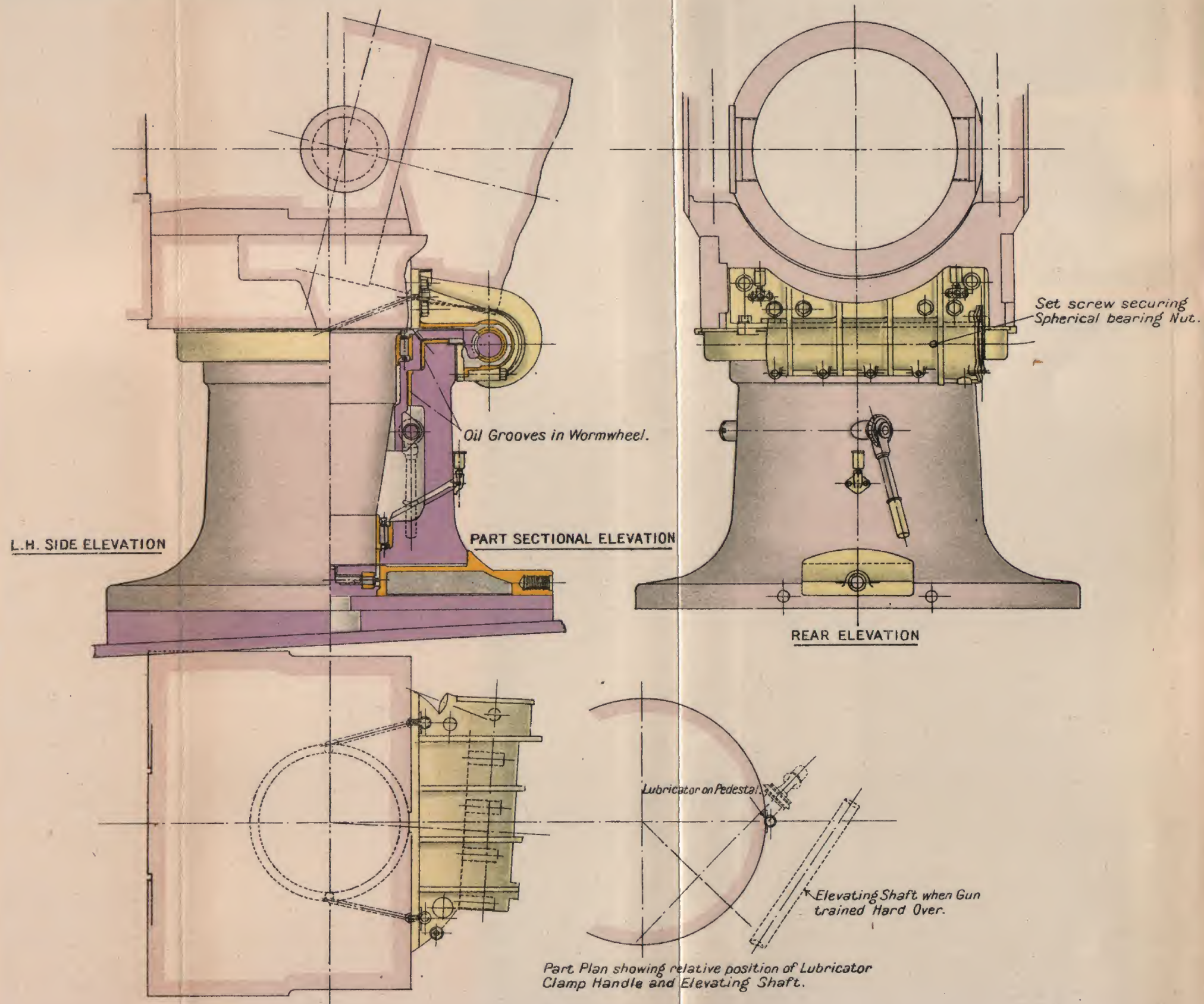
PART SECTION THROUGH TRUNNION. PART SECTION THROUGH TRUNNION BLOCK. PART ELEVATION.



ORDNANCE B.L. 6 INCH 45 CALIBRES.

PEDESTAL MOUNTING. P. MARK IX.

LUBRICATING ARRANGEMENT.

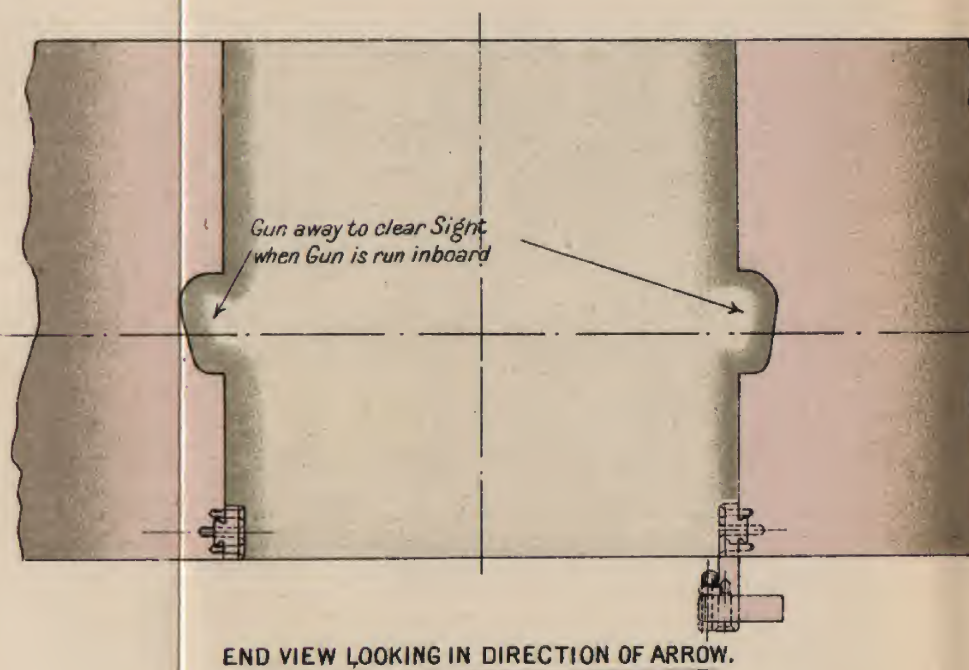
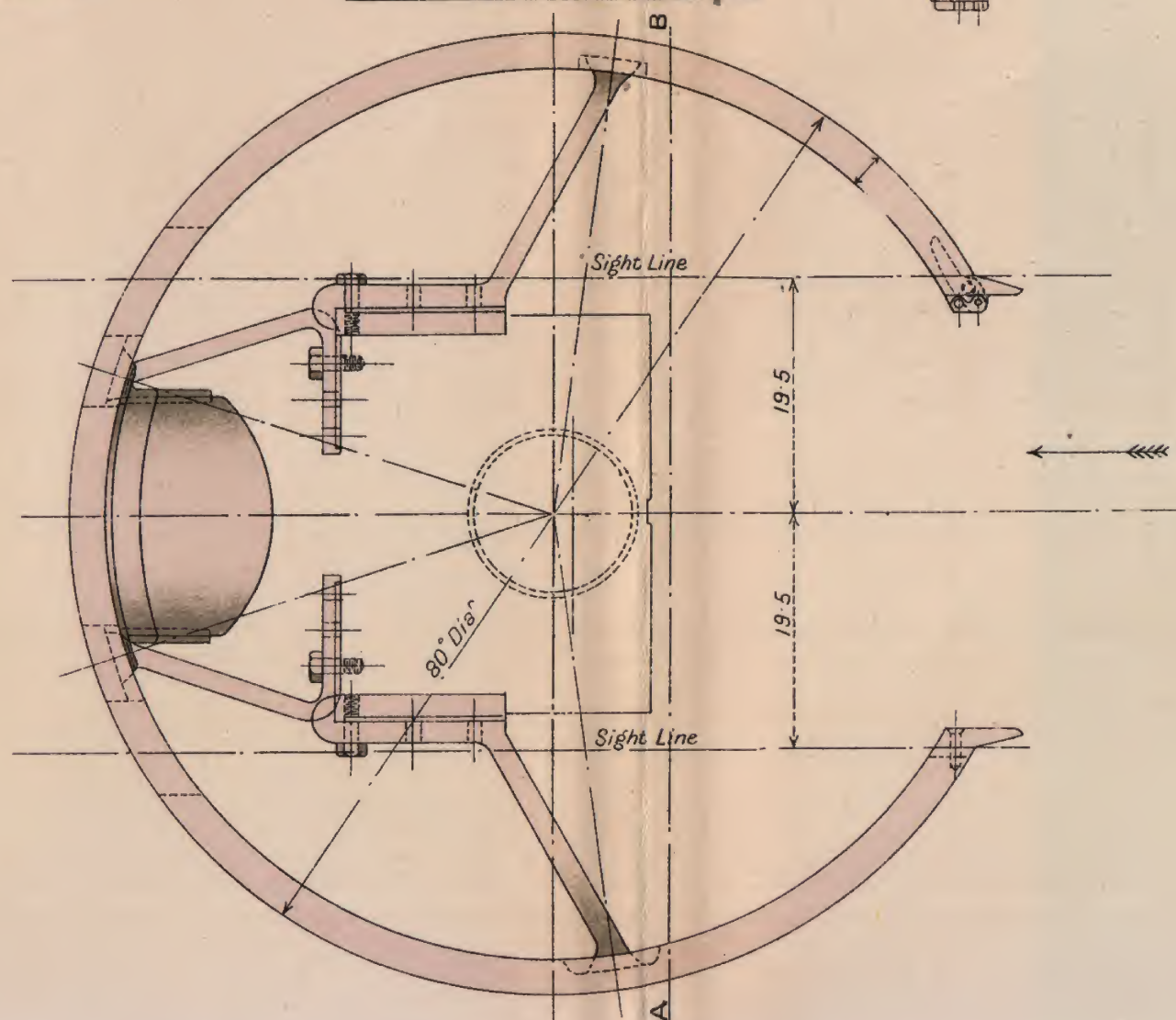
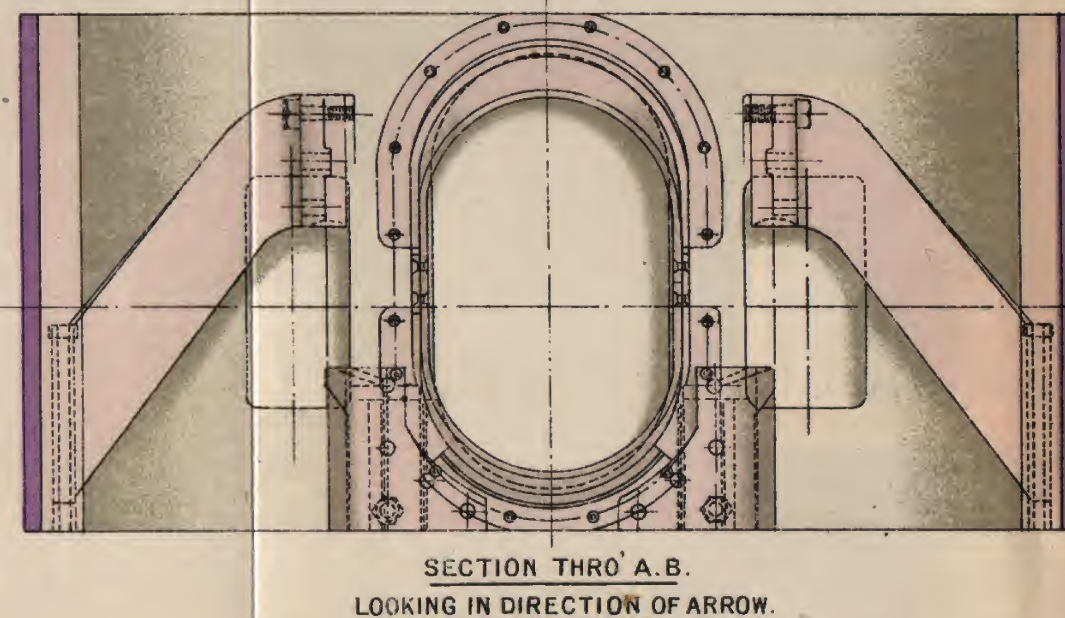
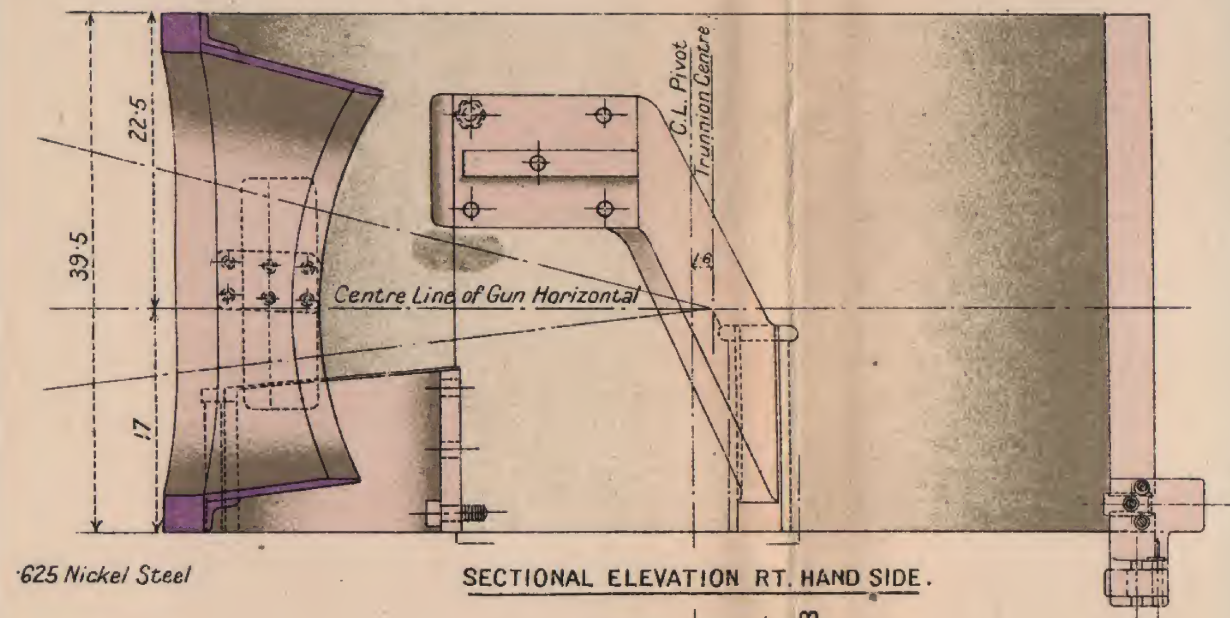




# ORDNANCE B.L. 6 INCH 45 CALIBRES.

## PEDESTAL MOUNTING. P.MARK IX.

### ARRANGEMENT OF SHIELD AND SHIELD SUPPORTS.

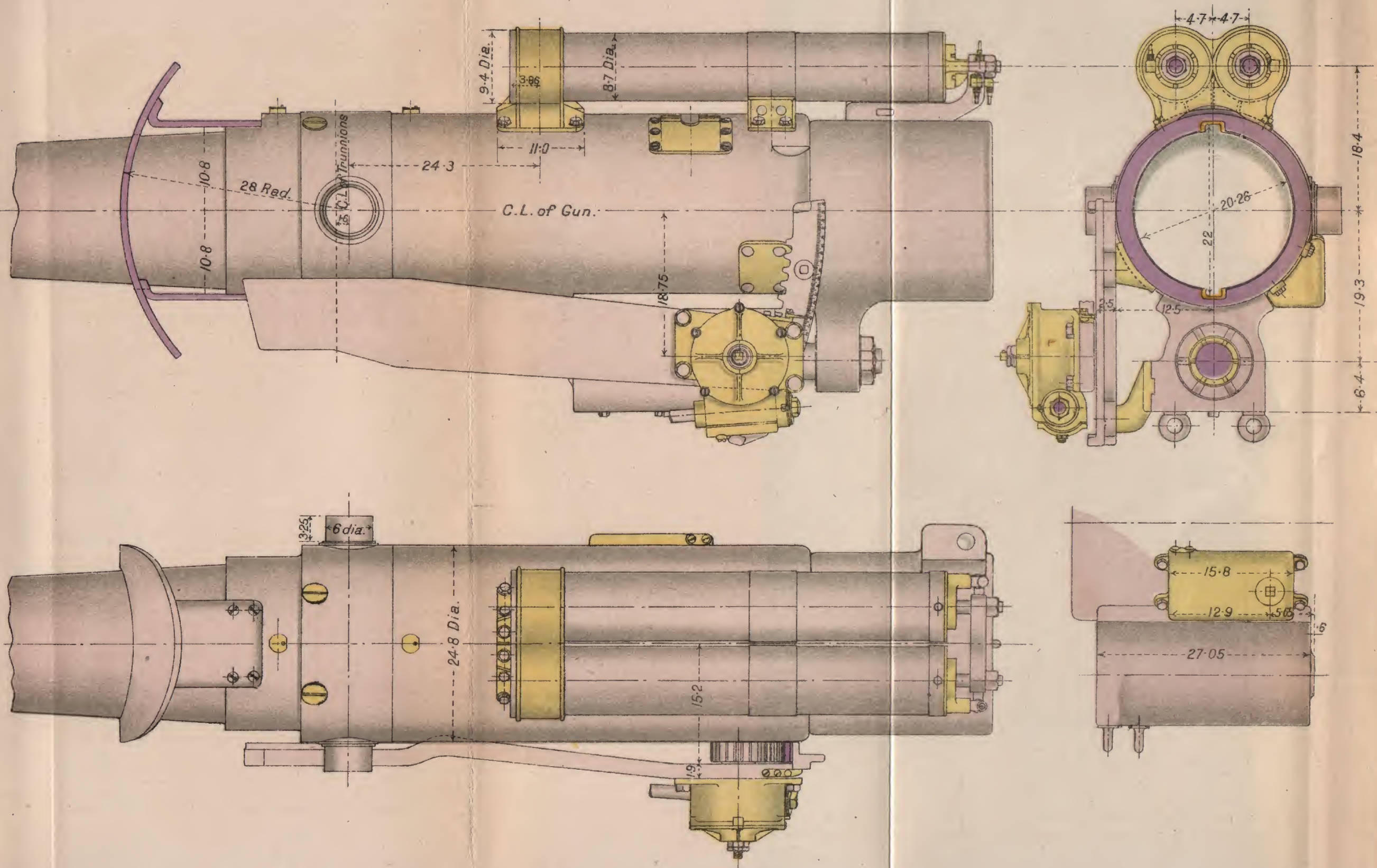




# ORDNANCE B.L. 6 INCH 45 CALIBRES.

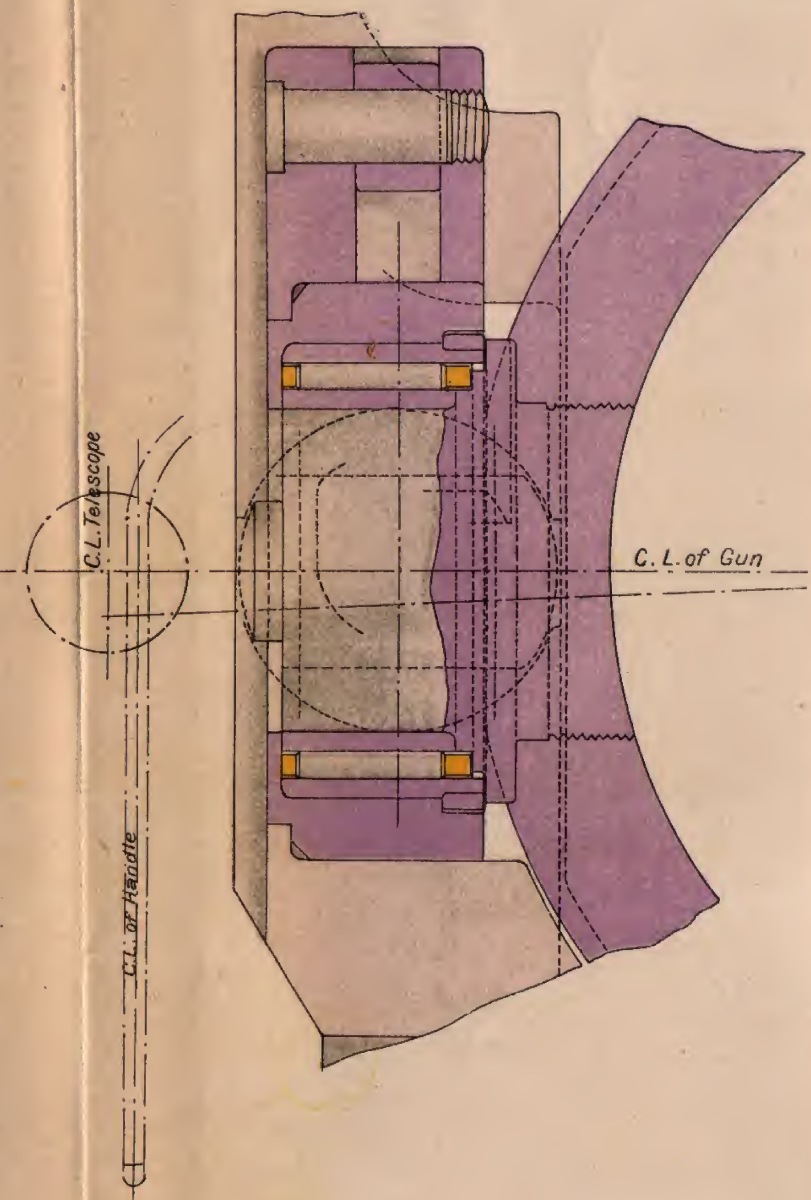
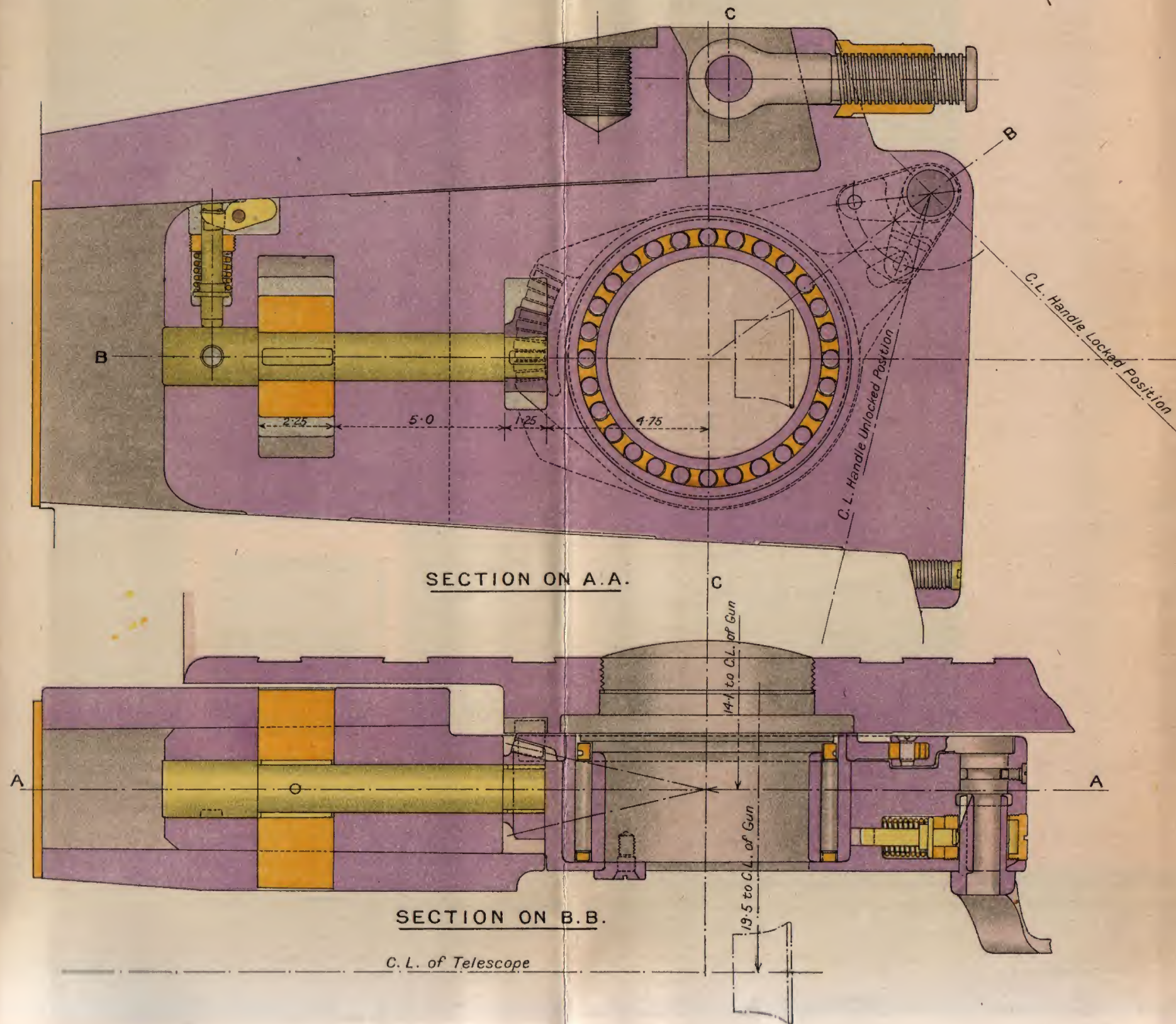
## PEDESTAL MOUNTING, P. MARK IX.

### ARRANGEMENT OF CRADLE AND FITTINGS.





ORDNANCE B.L. 6 INCH 45 CALIBRES.  
 PEDESTAL MOUNTING P. MARK IX.  
 ARRANGEMENT OF TRUNNION BLOCK.



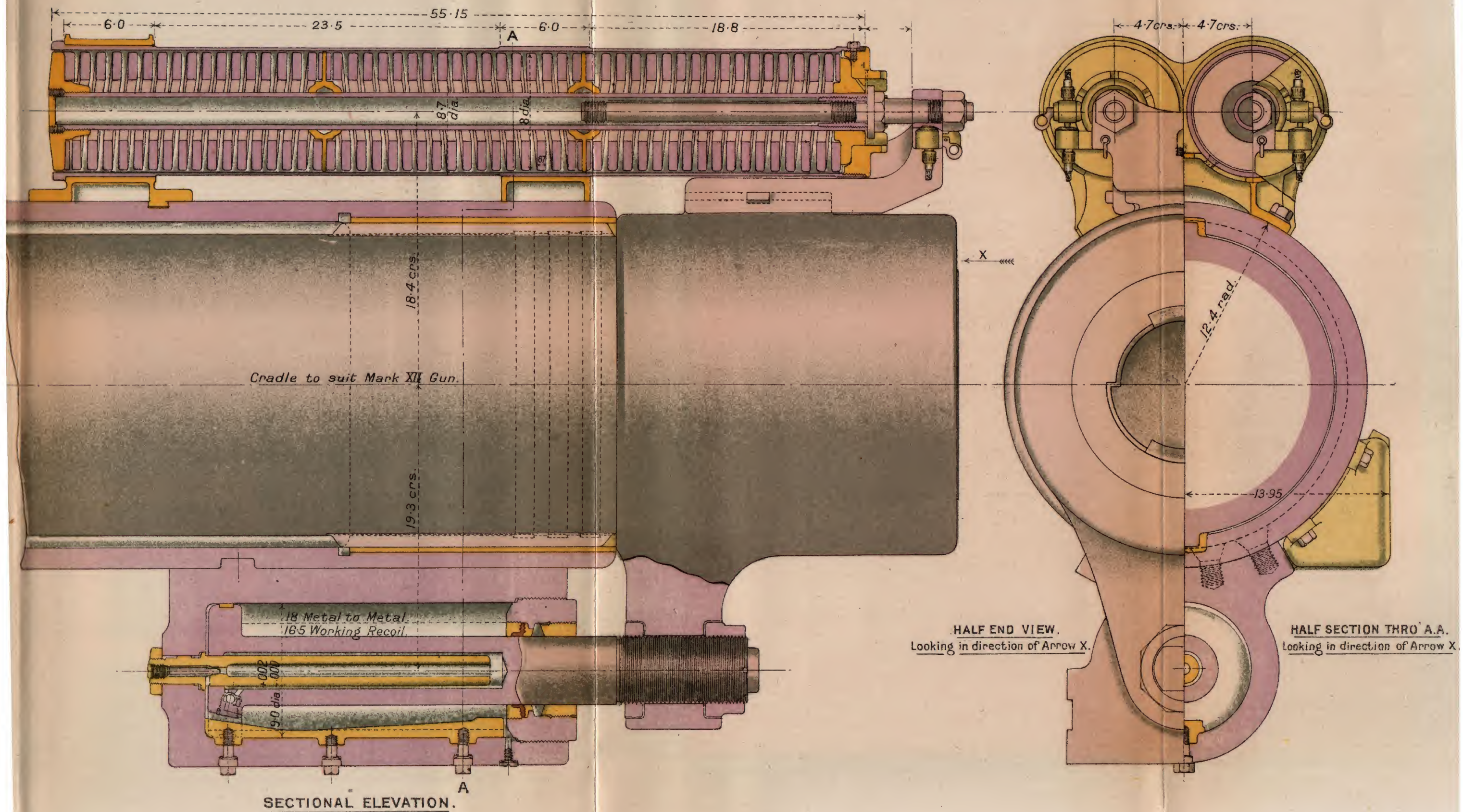
SECTION ON C.C.



# ORDNANCE B.L. 6 INCH 45 CALIBRES.

## PEDESTAL MOUNTING, P. MARK IX.

### SECTION THROUGH SPRING CASE AND RECOIL CYLINDER.





# ORDNANCE B.L. 6 INCH 45 CALIBRES.

## PEDESTAL MOUNTING. P. MARK IX.

### ARRANGEMENT OF ELEVATING GEAR.

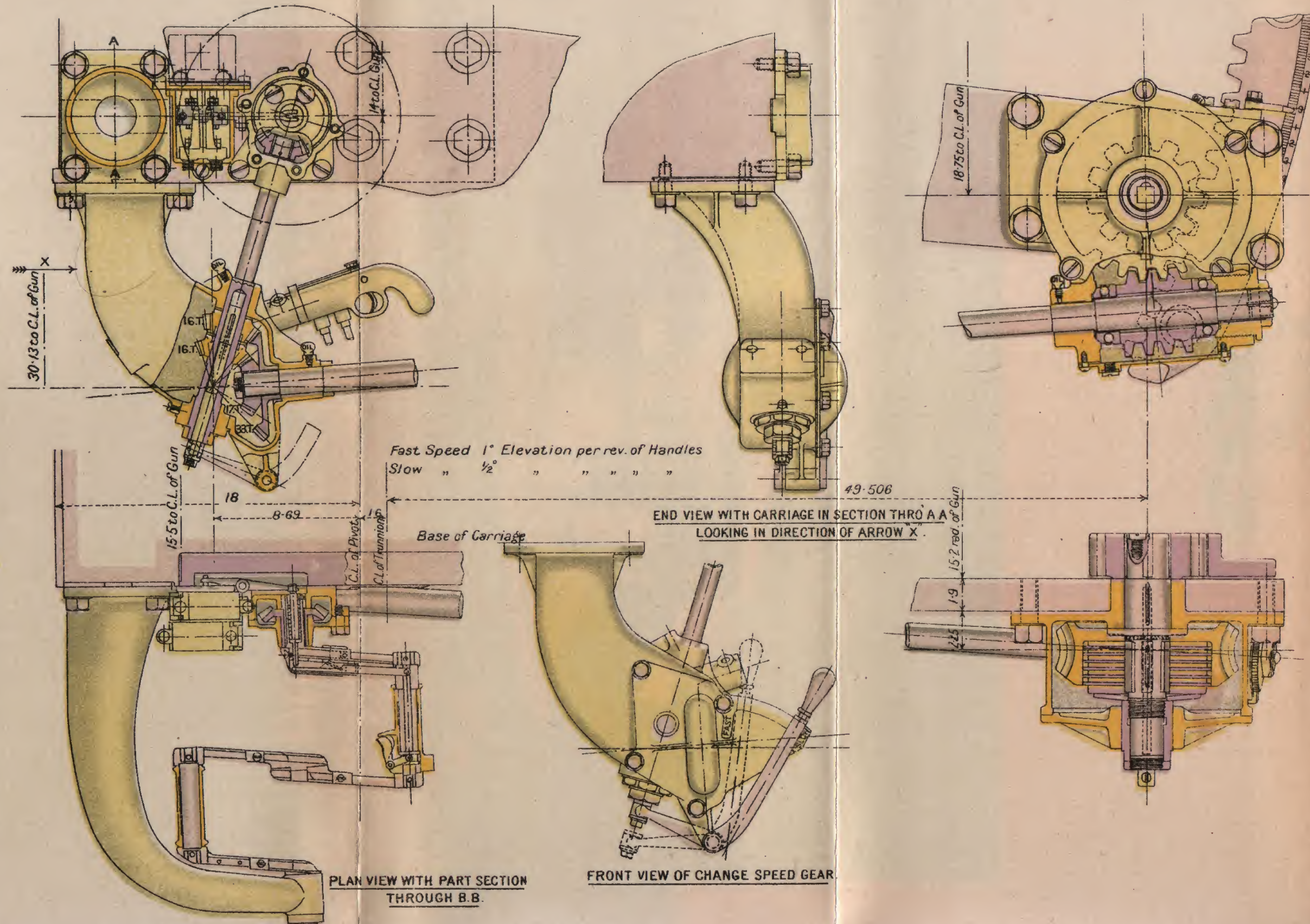
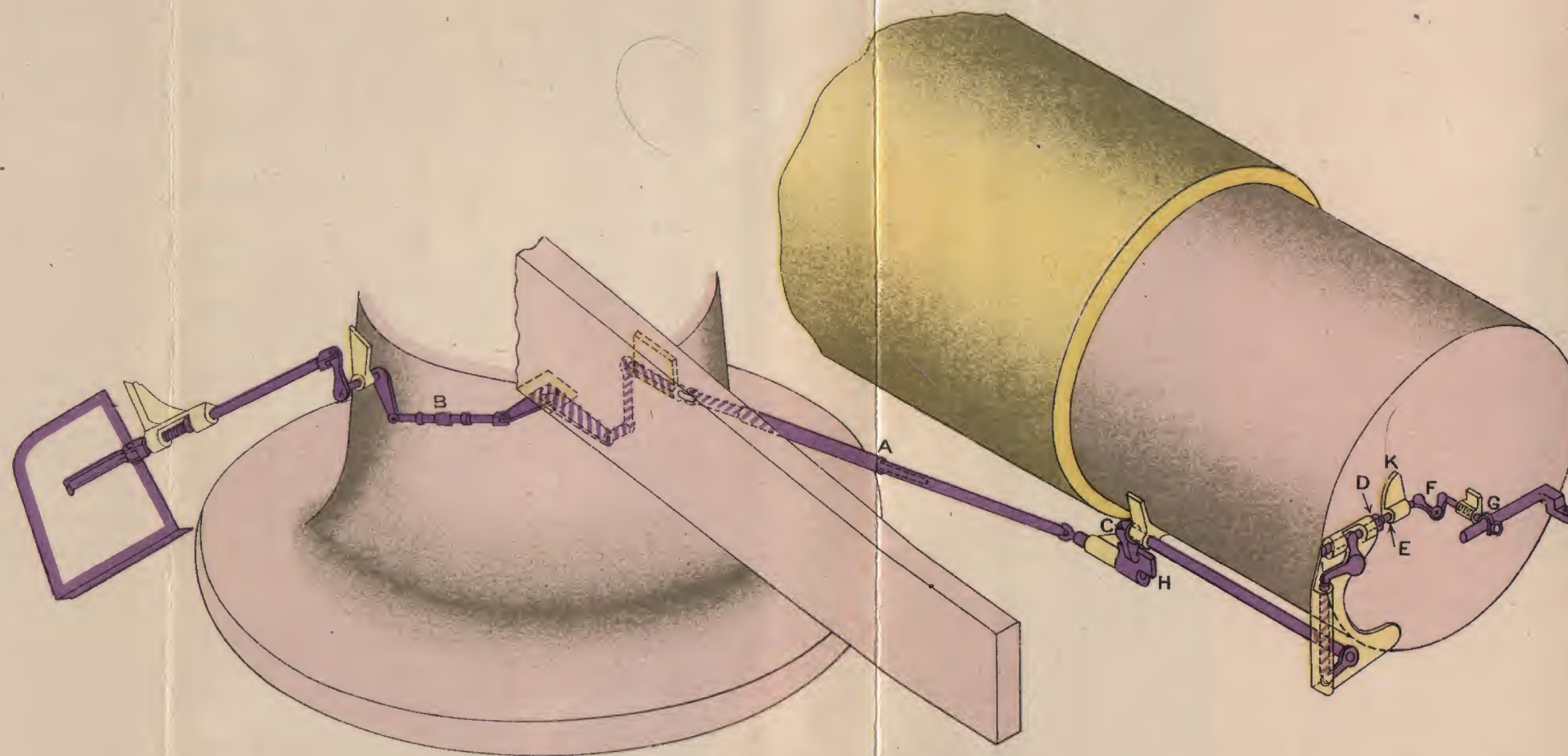


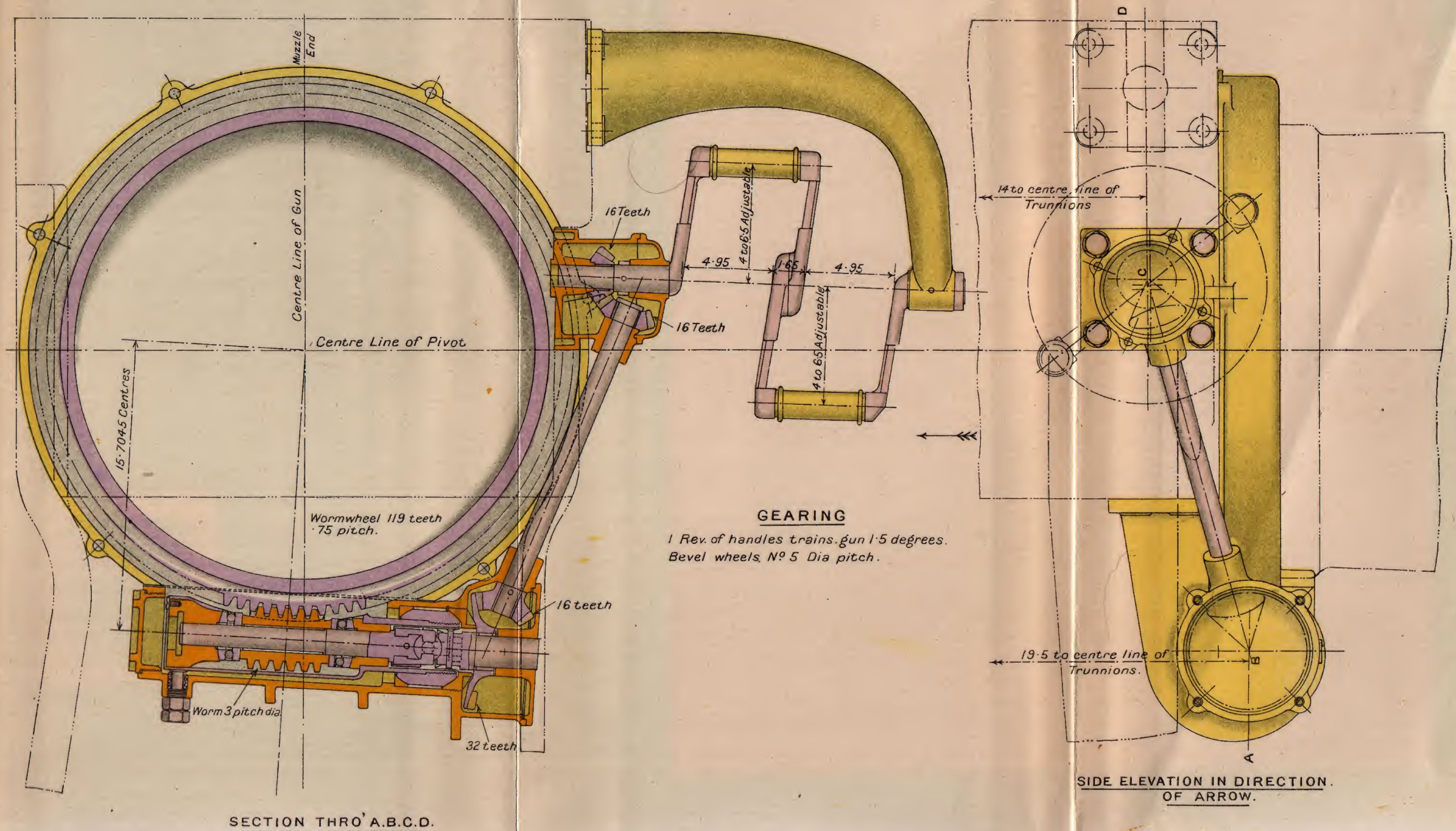


DIAGRAM OF PERCUSSION FIRING GEAR FOR  
6 IN. B.L., MARK XII GUN ON PIX MOUNTING.





ORDNANCE B.L. 6 INCH 45 CALIBRES.  
PEDESTAL MOUNTING. P. MARK IX.  
ARRANGEMENT OF TRAINING GEAR.





# DIAGRAM OF CIRCUITS.

6' P. IX.

FIGURE I.

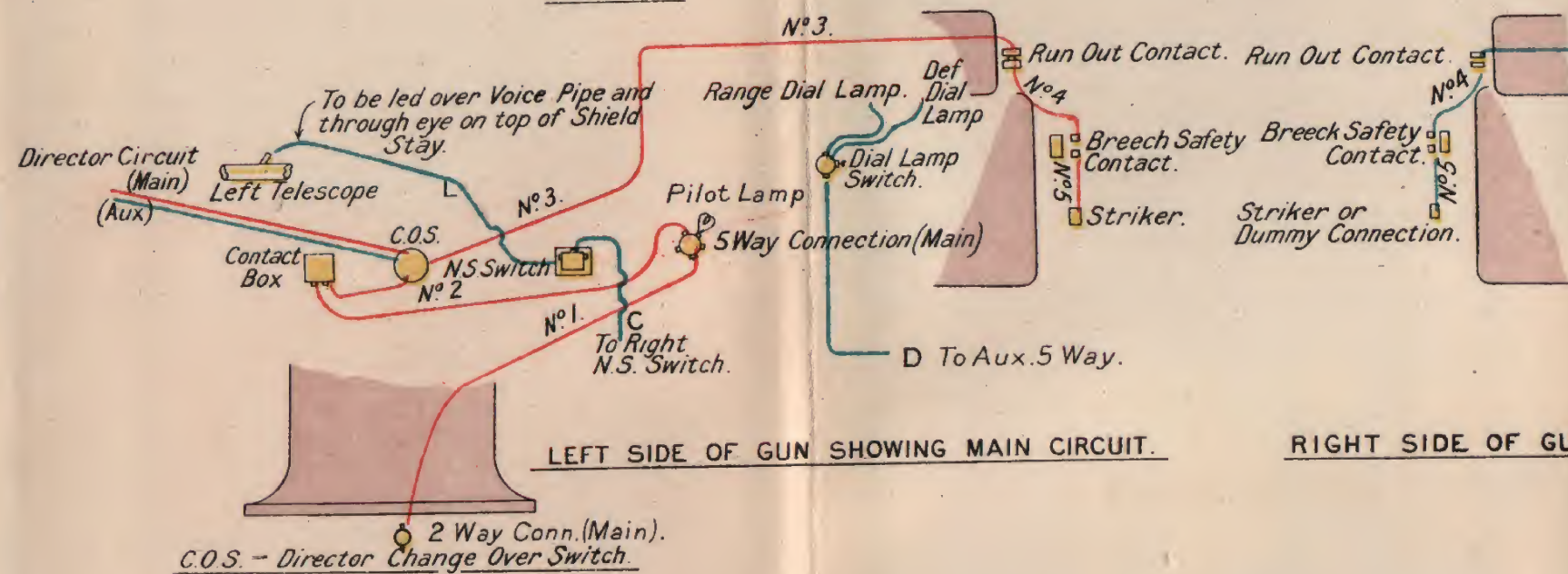
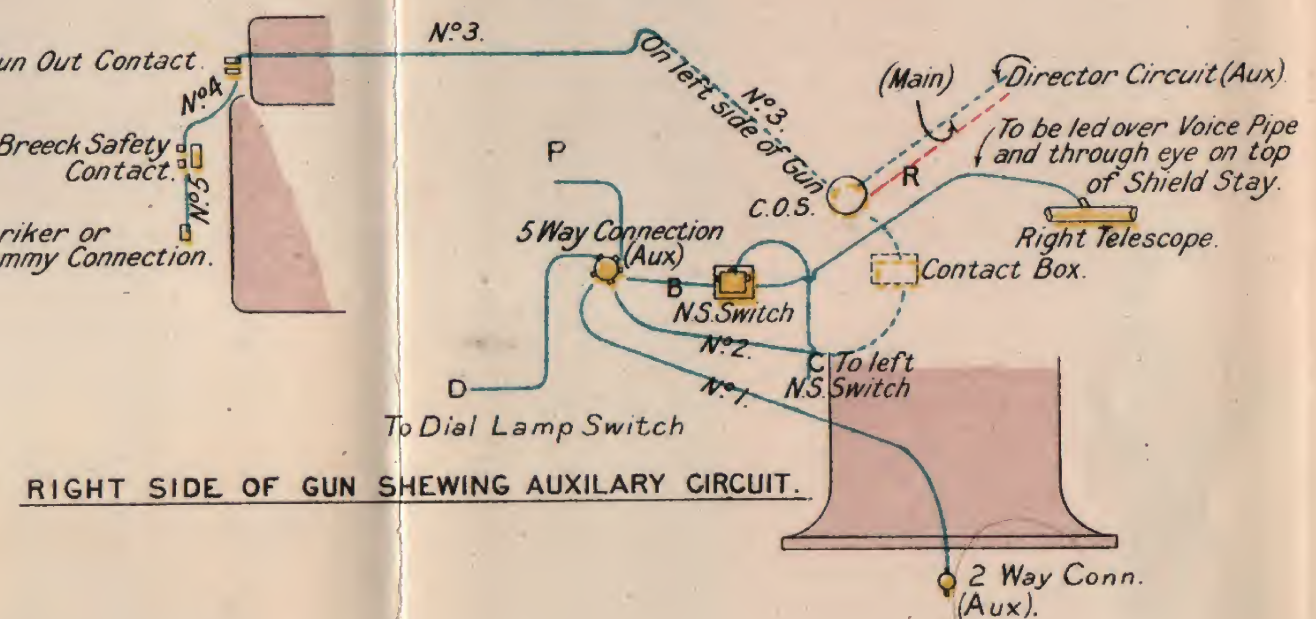


FIGURE II.



## LENGTHS OF CABLES.

### FIRING.

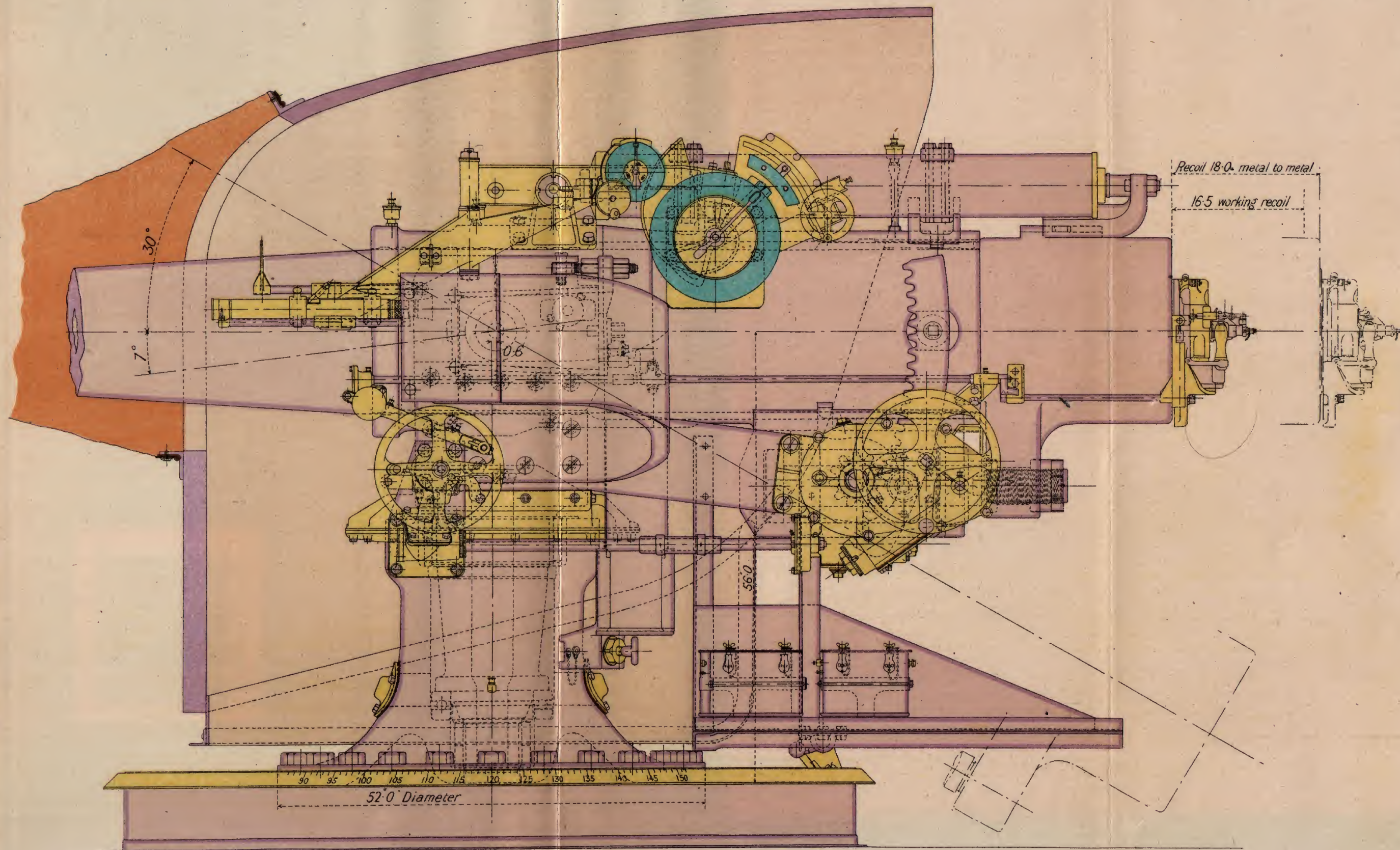
### NIGHT SIGHT.

No		LENGTH OF CABLES.	LETTER		
		MAIN AUX VARIES.			
1	2 Way on Pedestal to 5 Way.		B	5 Way to Night Sight Switch.	12"
2	5 Way to Contact Box.	47" 75"	C	Night Sight Switch to Night Sight Switch.	47"
3	Contact Box to Run Out Contact.	148" 162"	D	5 Way to Dial Lamp Switch.	about 70"
4	Run Out Contact to Breech Safety Contact.	45" 30"	L	N.S. Switch to Left Telescope.	75"
5	Safety Contact to Striker.	13" 13"	P	5 Way to Racer Lamp.	about 76"
			R	N.S. Switch to Telescope Right.	75"
				Dial Lamp Switch to Range Dial.	32"
				" " " " Def Dial.	43"

Whipped to gether  
for 12 Ins.



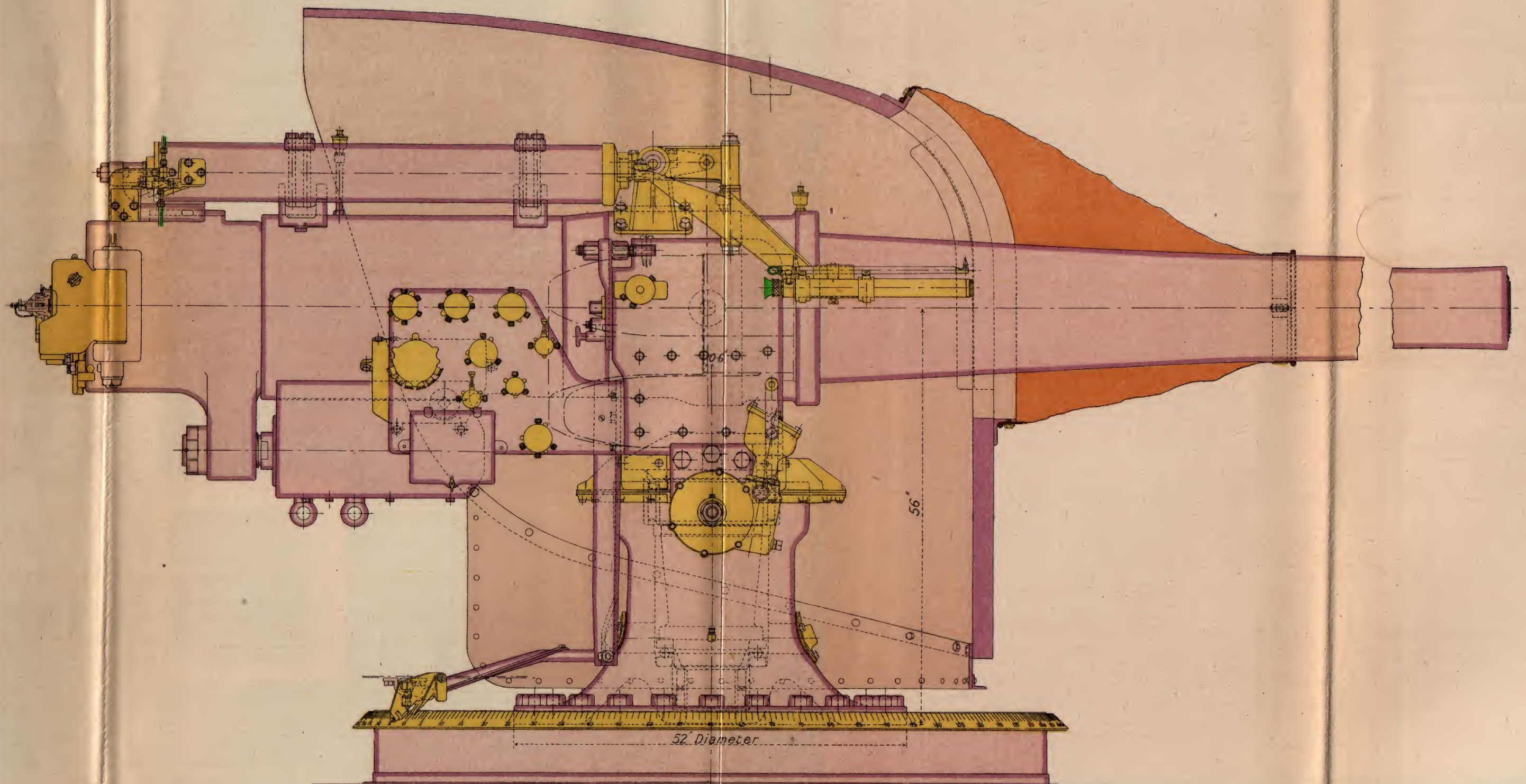
MOUNTING 6 INCH P. MARK XIII.  
GENERAL ARRANGEMENT - LEFT HAND SIDE.



LEFT-HAND SIDE ELEVATION

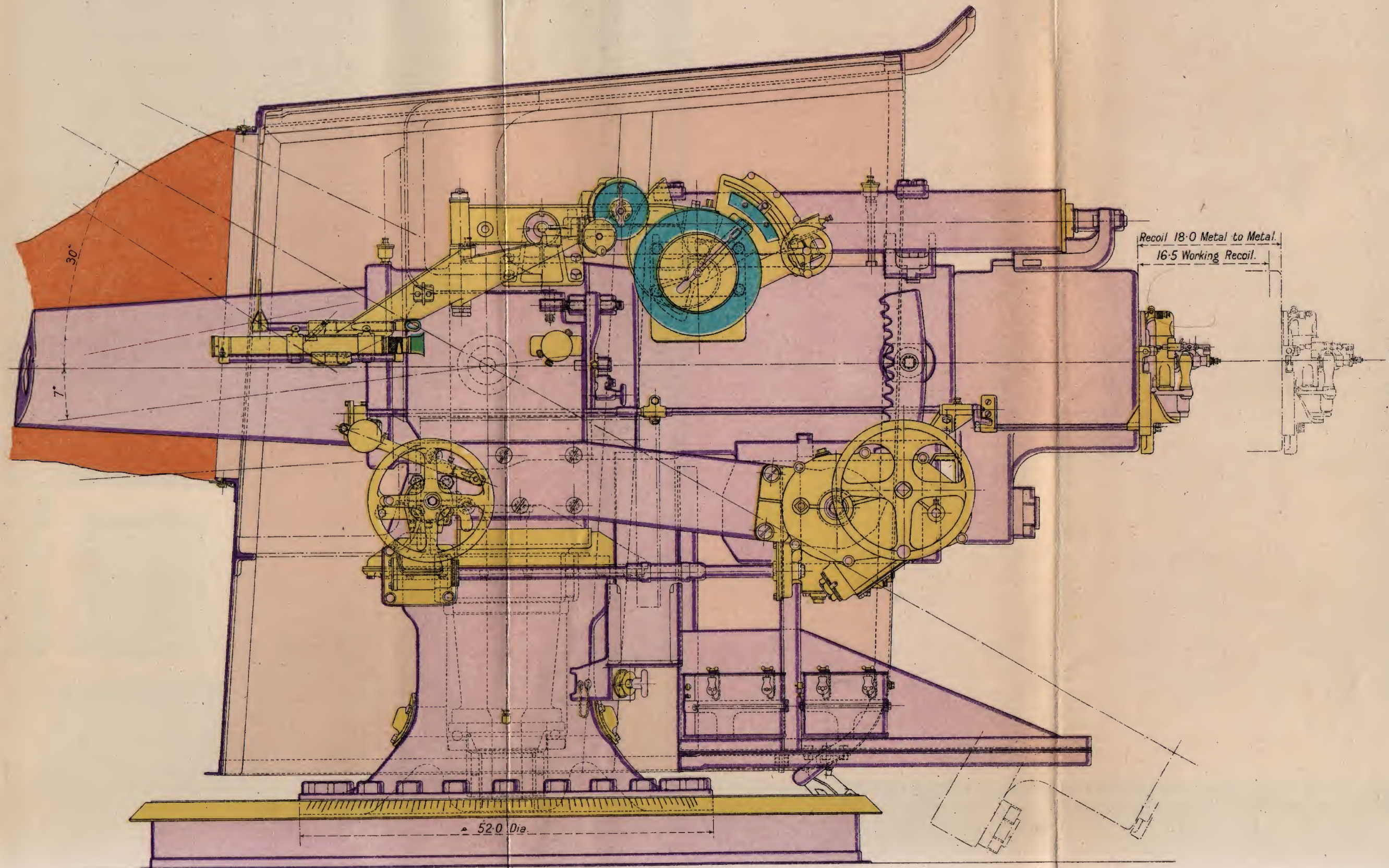


MOUNTING 6 INCH P MARK XIII.  
GENERAL ARRANGEMENT - RIGHT HAND SIDE.



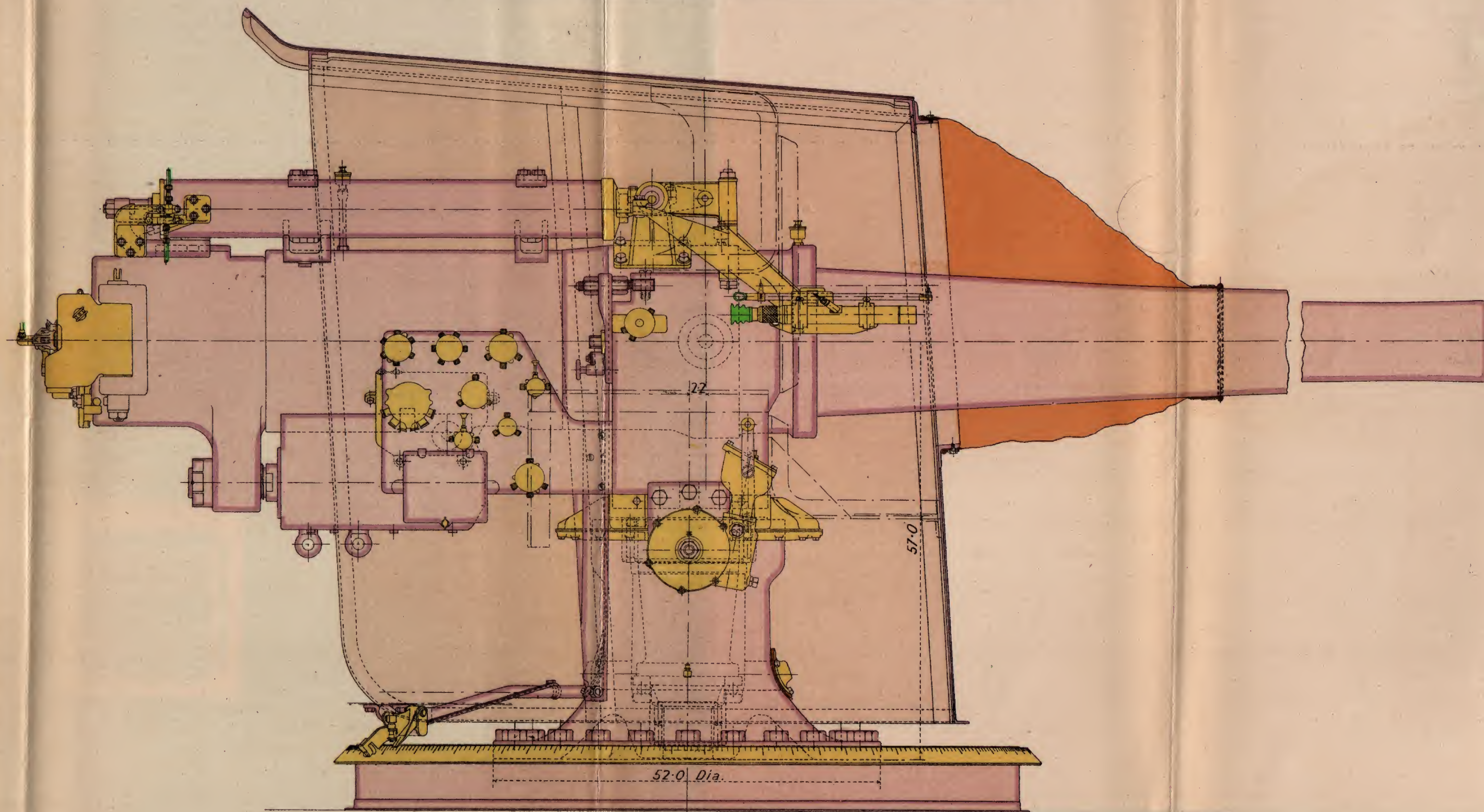


MOUNTING, 6 INCH. P. MARK XIII.\*  
GENERAL ARRANGEMENT - LEFT HAND SIDE.





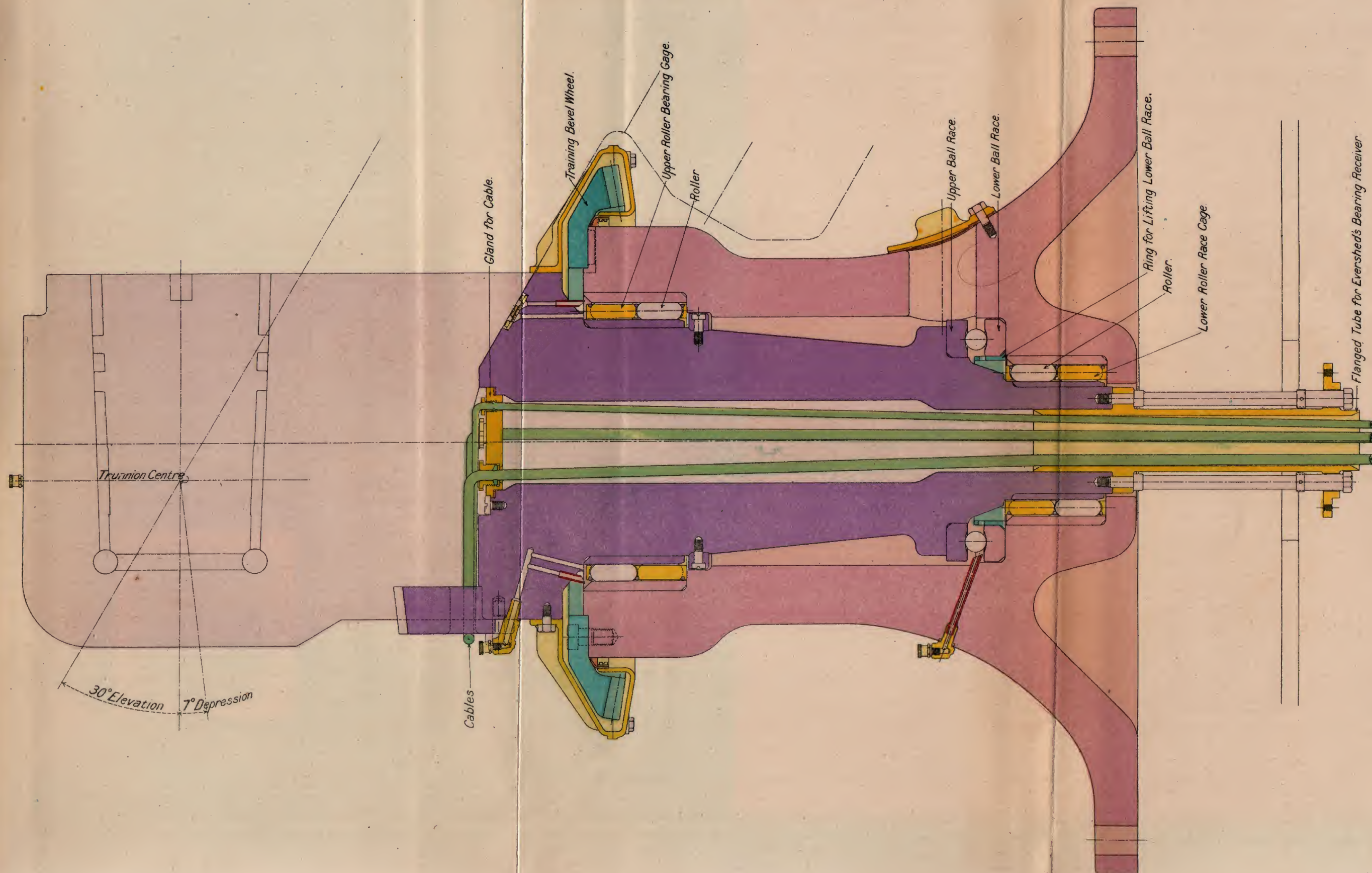
MOUNTING 6 INCH P MARK XIII.\*  
GENERAL ARRANGEMENT RIGHT HAND SIDE





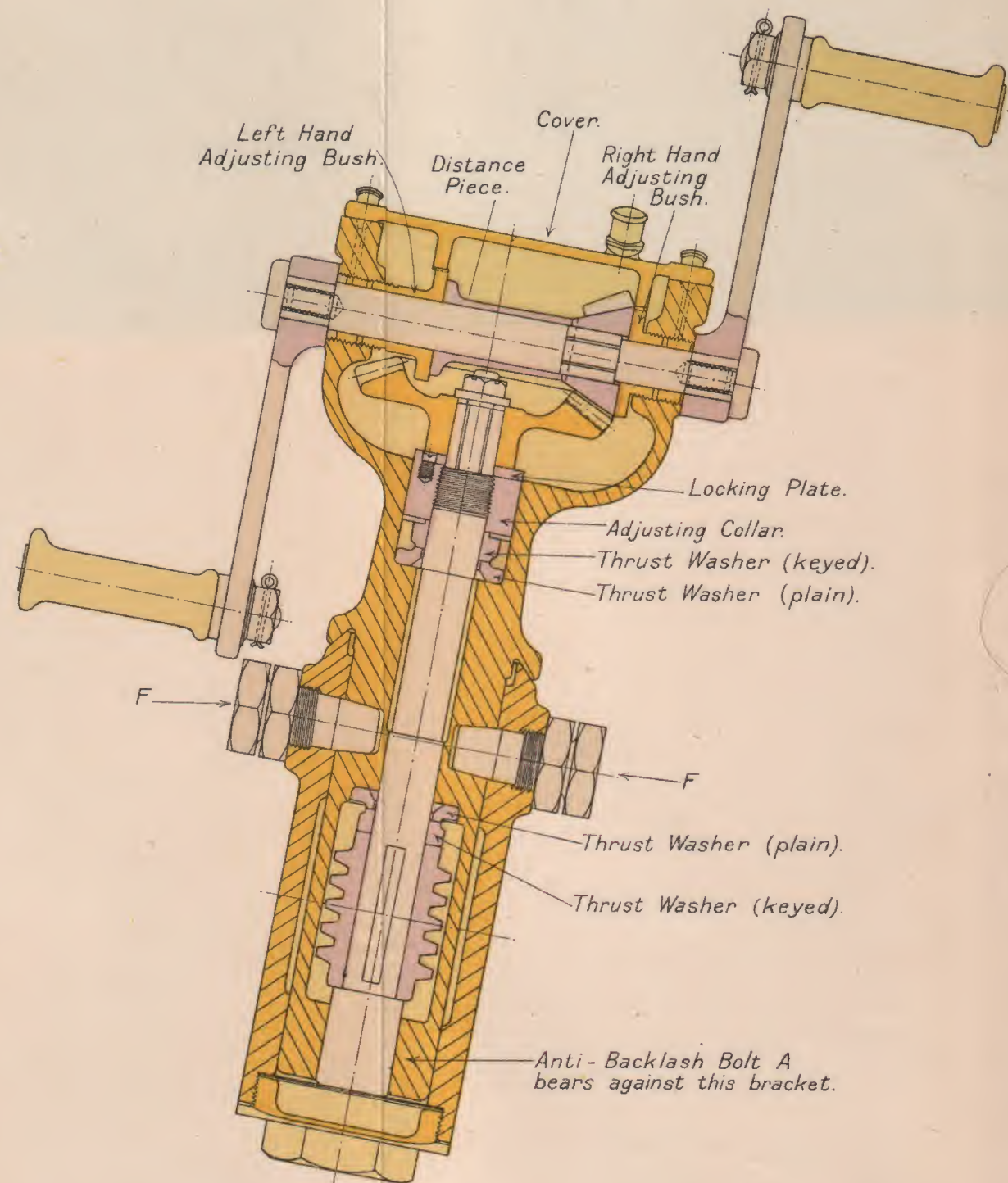
# MOUNTING 6 INCH P MARK XIII\*

## SECTION THROUGH PIVOT & PEDESTAL.





MOUNTING. 6 INCH. P. MARK XIII & XIII\*.  
ARRANGEMENT OF TRAINING HANDLES AND WORM.



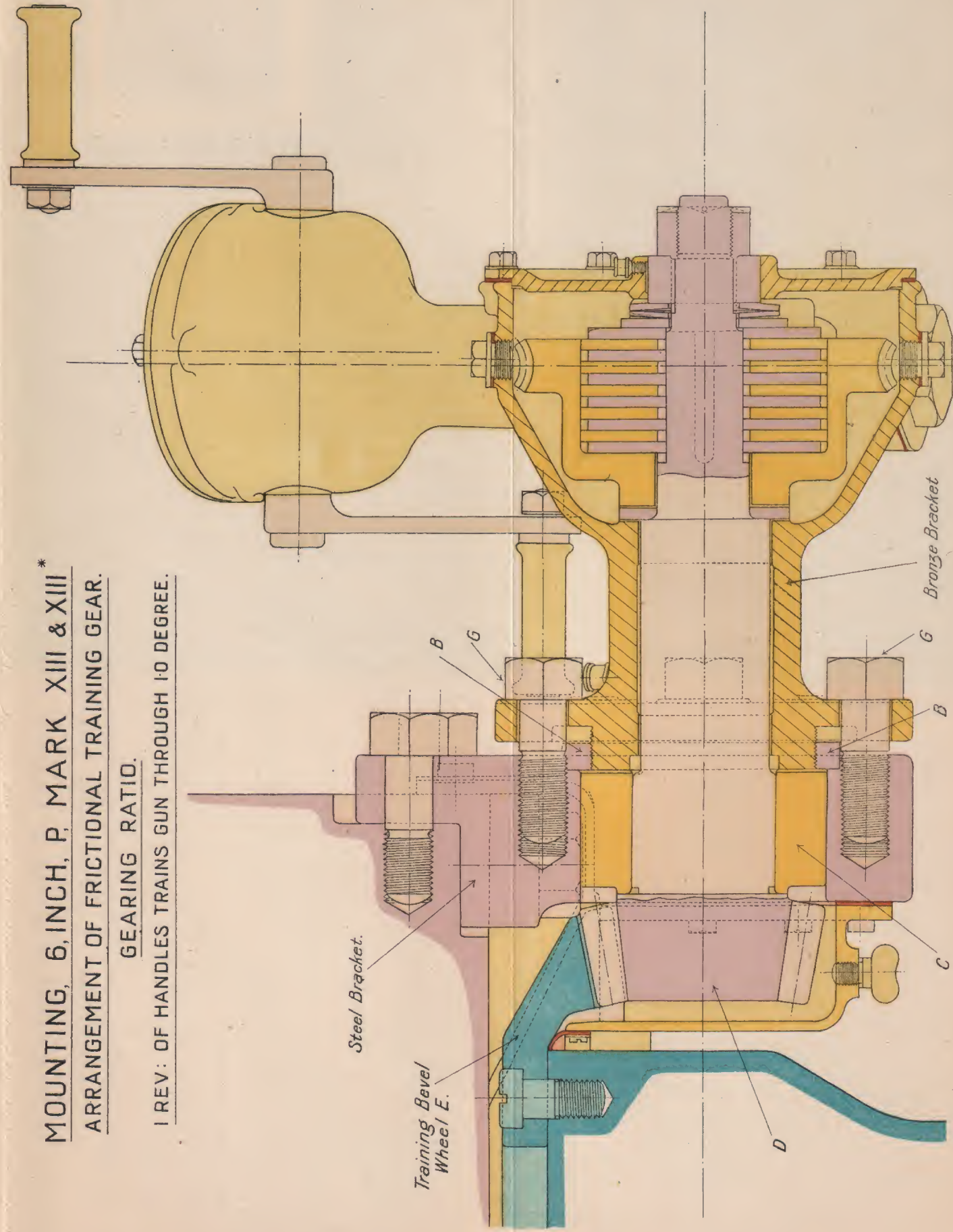
SECTION THROUGH  
WORMSHAFT BEARINGS.



MOUNTING, 6 INCH, P. MARK XIII & XIII\*  
ARRANGEMENT OF FRICTIONAL TRAINING GEAR.

GEARING RATIO.

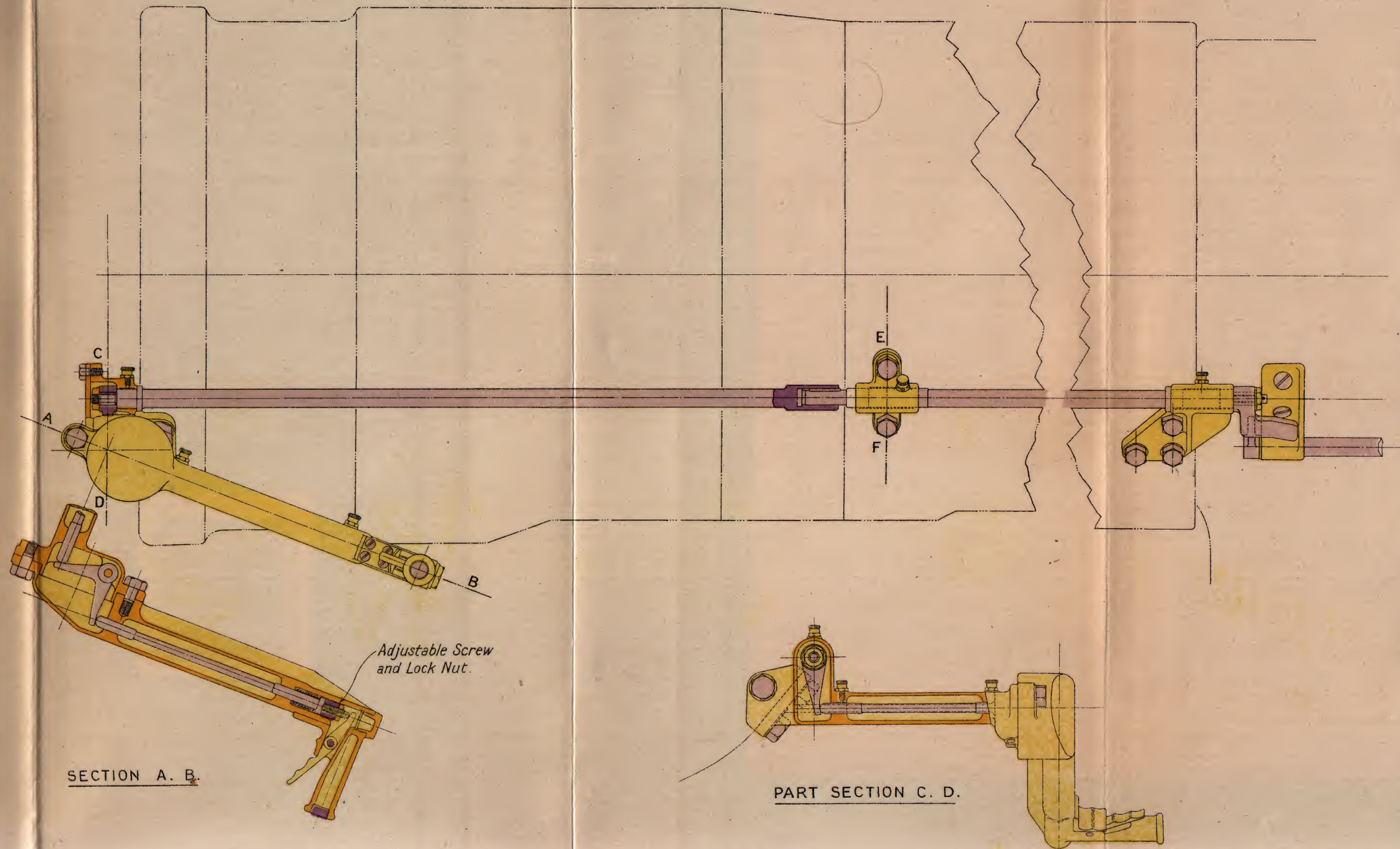
1 REV. OF HANDLES TRAINS GUN THROUGH 10 DEGREE.





MOUNTING, 6 INCH. P. MARK XIII & XIII\*.

ARRANGEMENT OF PERCUSSION FIRING GEAR.





# MOUNTING, 6 INCH P. MARK XIII. DIAGRAM OF FIRING AND NIGHT SIGHT CIRCUITS.

Main Cables, coloured Red.  
 Auxiliary Cables, coloured Blue.

## LENGTH OF CABLE.

IDENTIFICATION NO.	CABLE.	LENGTH IN INCHES
0	Battery box to battery change over switch	Main 104
0	" " " " " "	Aux 116
1	Dynamo to battery change over switch	Main
1	" " " " " "	Aux
2	Battery change over switch to circuit change over switch	Main 14
2	" " " " 6 way connection	Aux 20
3	Circuit " " " 6 " "	Main 12
3	" " " " 6 " "	Aux 19
3	6 way connection to firing pistol	Main 113
3	6 " " " " " "	Aux 112
4	Firing pistol to change over switch for firing circuit	Main 126
4	" " " " " " "	Aux 126
5	Change over switch for firing circuits to duplex interceptor	Main 59
5	" " " " " " "	Aux 65
6	Interceptor duplex contacts to safety contacts	Main 65
6	" " " " " dummy connection	Aux 65
7	Safety contacts to striker	Main 12
7	" " " " " " "	Aux 12
B	6 way connection to night sight switch R.H.	Main 39
C	L.H. Night sight switch to R.H. night sight switch	" 69
L	" " " " Telescope L.H.	" 48
R	R.H. " " " " R.H.	" 46
D	6 way connection main to dial lamp switch N°3	" 55
	Dial lamp switch N°3 to deflection dial lamp	" 48
	" " " " Range " "	" 30
	6 way connection to 3 way connection N°1.	" 20
3	" " " " dial lamp switch N°1	" 14
3	" " " " " N°2	" 18
	Dial lamp switch N°1 to Eversheds indicator	" 34
P	" " " " N°2 to pilot lamp	" 91
E	Battery box to earth	Main & Aux 15
	6 way connection main to elevating & training receiver	Main
	Dial lamp switch N°4 to 3 way connection N°2	"
	3 way connection to elevating receiver	"
	" " " " training " "	"

